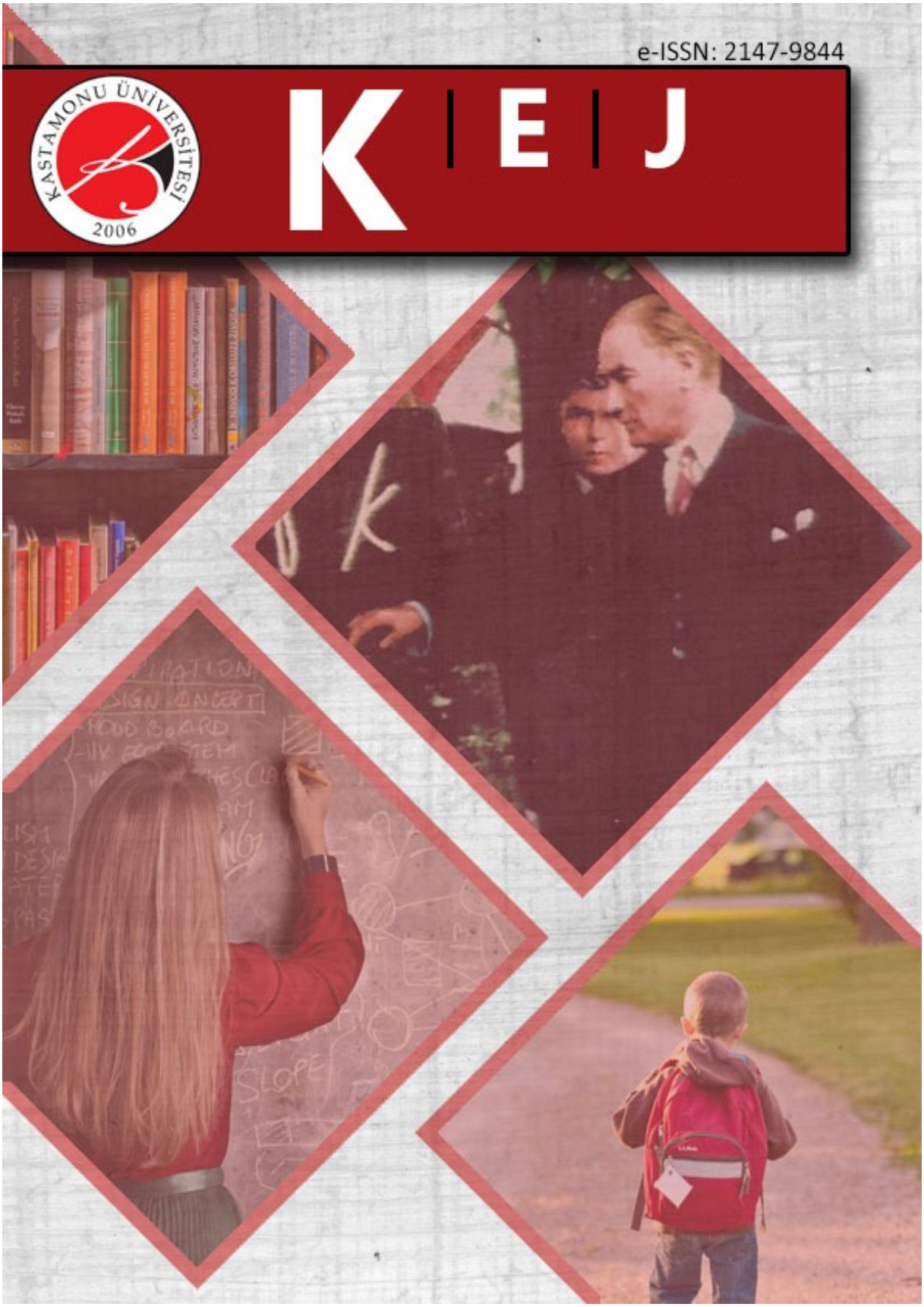

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| Research Article / Araştırma Makalesi |

Examining Positive Teacher Characteristics in Terms of Career Adaptability and Happiness Increasing Strategies

Pozitif Öğretmenin Yordayıcıları Olarak Kariyer Uyumu ve Mutluluğu Artırma Stratejileri

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Keywords

1.Positive teacher

2.Happiness increasing strategies,

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Abstract

Purpose: It was aimed to examine the relationship between positive teacher characteristics and teachers' career adaptability and the strategies they use to increase happiness.

Design/Methodology/Approach: In the study, the relationships between the variables were analyzed using descriptive statistics, correlation analysis and multiple regression analysis techniques. The research was conducted with teachers working in various public secondary education institutions. The gender of the teachers participating in the study is 180 female and 58 male. The ages of the teachers are between 24 and 50. Their average age is 32.07. The study's data were collected through the "Positive Teacher Scale, Career Adaptability Scale and Happiness Increasing Strategies Scale."

Findings: According to the results of the research, it was seen that positive teacher characteristics were positively related to career exploration, responding positively to the environment, and using mental control strategies.

Highlights: On the other hand, there is a negative relationship between positive teacher characteristics and the increased happiness strategy of resting the body. In order to develop positive teacher qualities, specific happiness-increasing strategies and career exploration might be used.

Öz

Çalışmanın amacı: Bu araşırmanın amacı, pozitif öğretmenin kavramının kariyer uyumu ve mutluluğu artırma stratejileri kavramları ile ilişkili olup olmadığını belirlemektir.

Materyal ve Yöntem: Araştırmada değişkenler arasındaki ilişkiler betimsel istatistikler, korelasyon analizi ve çoklu regresyon analizi teknikleri kullanılarak analiz edilmiştir.Araştırma çeşitli kamu ortaöğretim kurumlarında aktif olarak çalışan öğretmenler ile gerçekleştirilmiştir. Çalışma kapsamında toplam 6 branşta 238 öğretmene ulaşılmıştır. Çalışmaya katılan öğretmenlerin cinsiyet bilgileri ise 180 kadın ve 58 erkektir. Öğretmenlerin yaşları 24-50 arasındadır. Yaşlarının ortalaması ise, 32.07'dir.Araştırmanın verileri "Pozitif Öğretmen Ölçeği, Kariyer Uyum Ölçeği ve Mutluluğu Artırma Stratejileri Ölçeği" aracılığı ile toplanmıştır. Ayrıca örneklem grubunun demografik özelliklerini belirlemek için araştırmacılar tarafından "Kişisel Bilgi Formu" oluşturulmuştur.

Bulgular Araştırma sonuçlarına göre, pozitif öğretmen özelliklerinin, kariyer uyumunun kariyer keşfi boyutu ile pozitif yönde ilişkili olduğu görülmüştür.

Önemli Vurgular: Öte yandan kariyer planı ile pozitif öğretmen özellikleri arasındaki ilişkinin önemli ve anlamlı olmadığı sonucuna varılmıştır. Mutluluğu artırma stratejilerinden üçü pozitif öğretmen özellikleri ile pozitif yönde biri ise negatif yönde anlamlı ve önemli ilişkiler ortaya koymuştur.

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INTRODUCTION

In the formal education system, starting from the preschool period until the high school period, students have specific developmental tasks. For students to fulfill these developmental tasks healthily, teachers have important roles. In particular, it has been demonstrated that teachers significantly affect students' feelings, thoughts and behaviors (Spilt, Koomen, & Thijs, 2011; Tsouloupas, Carson, Matthews, Grawitch, & Barber, 2010; Eryılmaz & Bek, 2018). According to Seligman et al. (2009), positive education means using the power of teachers to provide students with traditional education and teaching skills on the one hand and to provide educational activities to reach happiness on the other hand. It has been revealed in a study that teachers have an effect of approximately twenty-five percent on the academic achievement and general happiness of students in their schools (Eryılmaz, 2014). Positive education helps students to expand their perspectives and improve themselves by showing reactions that will bring positive emotions to students in the classroom environment. At the same time, it can reduce the negative effects of the past on individuals (Fredrickson, 1998). Based on this information, it is significant for the role of teachers that teachers have the effect of revealing positive emotions in students (Eyılmaz & Bek, 2018).

One of the crucial elements of the positive education process is positive teachers. Positive teachers are those who increase positive emotions and decrease negative emotions in students (Eryılmaz, 2017; Eyılmaz & Bek, 2018; Özbağır, 2019). Some features distinguish positive teachers from other teachers. These critical traits are extroversion and positive teachers' extrovert personality traits (Eryılmaz, 2017; Eyılmaz & Bek, 2018). According to the five-factor model, individuals have two personality traits closely related to their level of well-being. It has been concluded that individuals with extrovert personality traits, which is one of them, feel happier in daily life (Myers & Diener, 1995). Having this feature has a significant impact on the well-being of not only teachers but also students (Eryılmaz, 2014; Eryılmaz & Öğülmüş, 2010; Kim, Dar-Nimrod, & MacCann, 2018; Vorkapić & Peloza, 2017).

Positive teachers are also teachers who satisfy students' competence needs. The innate need for competence includes ability and competence (Ryan & Deci, 2000). As individuals satisfy their competence needs, their well-being levels increase (Deci & Richard, 2000; Ryan & Deci, 2000; Reis, Sheldon, Gable, Roscoe & Ryan, 2018). Positive teachers understand the importance of satisfying this need both intuitively and experientially. As a natural consequence of this situation, they try to satisfy the competency needs of the students in the lessons.

At the same time, by explaining the subjects at a level that students can understand, they also cause students to experience flow (Eryılmaz, 2017). Flow theory refers to a person's being controlled and focused, that is, motivation, while overcoming the difficulties they encounter to fulfill their life duties (Csikszentmihalyi, 1988; Egbert, 2004). As a result of the research, it was found that doing flow activities in daily life increases the subjective well-being of individuals in general (Moneta, 2004).

As a result of the research, it has been concluded that teacher support is very effective in the success and motivation of students (Klem & Connell, 2004). Another characteristic of positive teachers is positive relationships with students (Eryılmaz, 2017; Eyılmaz & Bek, 2018; Özbağır, 2019). Teachers' interest in their students, being prepared for the lesson, and taking care of their students contributed positively to the development of students (Skinner et al., 2008; Furrer & Skinner, 2003; Skinner & Belmont, 1993).

Another positive teacher characteristic is that they increase their students' engagement with the lesson (Eryılmaz, 2017; Eyılmaz & Bek, 2018; Özbağır, 2019). Fredickson (2003) states that while the teacher carries out learning and teaching activities in the classroom, it is necessary to create an environment in which students will feel happy and ensure the participation of students in the lesson. In this way, learning is increased by the teacher he wants to learn. As a result, when students establish an emotional bond with the school and the school environment, their adaptation to school and learning processes are positively affected (Mouton & Hawkins, 1996).

Positive teachers differ from other teachers because they concretize the subject in the teaching process (Eyılmaz & Bek, 2018). According to Kolb's learning style model, Concrete learning is vital for students to involve themselves in new experiences, observe these experiences, and form theories as a result of their observations (Kolb, 1976). Positive teachers embody the subject and encourage students to overcome difficulties. Thus, students have some skills to overcome difficulties (Özbağır, 2019).

While individuals are performing their jobs, there is a need for tools to facilitate this process. One of these tools is career adaptability. Career adaptability is adapting to the changes and transformations experienced by individuals during the professional development process. Individuals can resolve the changes in career fields, emerging crises or confusions, and career decision-making processes by using their adaptability skills (Savickas, 2005; Stumpf, Colarelli, & Hartmann, 1983; Zikic & Klehe, 2006). In general, teachers' career adaptation and career development desires and expectations are closely related to the learning service they provide to their students and their contribution to society (Steger, Pickering, Shin, & Dik, 2010). The

increase in teachers' career adaptability positively affects their students' academic success and social-emotional development (Eryılmaz & Kara, 2017; Sapsağlam, Karabulut & Ekici, 2021). Although the importance of career adaptability for teachers and students is evident (Eryılmaz & Kara, 2021; Eryılmaz, Satici & Deniz, 2020), it is seen that studies examining career adaptability and positive teacher characteristics are not available in the literature.

Positive teachers create positive student emotions (Eyılmaz & Bek, 2018). In addition to all these, positive teachers also need to increase their level of well-being like every human being. In this context, we come across strategies that increase the happiness or well-being of individuals. Strategies to increase happiness have been discussed by many researchers (Fordyce, 1983; Eryılmaz, 2010; Eryılmaz, 2017; Tkach & Lyubomirsky, 2006). Adults increase their happiness by reacting positively to the environment, satisfying their desires, performing mental control, fulfilling the requirements of religious belief, resting their bodies and exhibiting happiness-oriented behaviors (Eryılmaz, 2017).

It is significant for both students and teachers to be happy in the educational environment in terms of achieving the purpose of education. Positive education and training practices enable the development of academic skills and increase happiness. It is aimed to give traditional education gains with positive education practices and to use and encourage skills to increase happiness (Seligman et al., 2009). In studies on teachers' happiness, it is found that teacher happiness or well-being is related to a sense of meaning (Lavy & Bocker, 2018), strategy use (De Stercke, Goyette & Robertson, 2015), teacher health (Benevene et al., 2019), gratitude and forgiveness (Chan, 2013). However, no studies examine the relationship between teachers' use of happiness-enhancing strategies and positive teacher characteristics. However, the happiness strategies used by positive teachers will inevitably reflect on their teaching characteristics.

The teaching profession is a profession that contributes directly and indirectly to the lives of individuals. Teachers who carry out this profession are examined under various headings (Eryılmaz, 2014). Teachers who are influential in students' learning and happiness are called positive teachers (Eryılmaz & Bek, 2018). Studies show that the characteristics of teachers have a significant effect on student success and happiness (Amon & Reichel, 2007; Eryılmaz, 2014; Grieve, 2010; Polk, 2006). The teaching profession consists of tiring, emotionally exhausting activities that involve a long process (Eryılmaz & Kara, 2021). Positive characteristics such as confidence, self-efficacy, optimism, extroversion, hope and psychological resilience that make teachers solid and resilient can help them both be happy and prosperous in their profession (Eryılmaz, 2013). One of the mentioned positive characteristics is positive teacher characteristics. Identifying the factors affecting positive teacher characteristics can be an essential tool for teacher education and teaching practices, and student success. As a result, this study aimed to examine the relationship between positive teacher characteristics and teachers' career adaptability strategies to increase happiness.

METHOD/MATERIALS

Research Design

This research is a quantitative study. The study's dependent variable is positive teacher characteristics; the independent variables are career adaptability and strategies to increase happiness. The study was carried out on teachers. As inclusion criteria, the criteria of not having any psychiatric diagnosis, being between the ages of 24-50 and working in an institution as a teacher were determined. The data in the study were collected on the principle of voluntariness. Ethics committee approval was obtained for the study.

The study analyzed the relationships between the variables using descriptive statistics, correlation analysis and multiple regression analysis techniques. Before starting the regression analysis, the data were examined according to the regression preconditions. In the study, first of all, skewness and kurtosis values were examined. As seen in Table 1, the skewness and kurtosis values are close to the normal distribution.

Table-1 Skewness and kurtosis values

Dimensions	Skewness	Kurtosis
Career plan	.449	-.515
Career exploration	-.543	-.459
Reacting positively to the environment	-.178	.425
Rest the body	-.389	-.137
Satisfaction of desires	-.343	-.275
Happiness oriented behaviors	-.376	-.449
Mental control	-.289	.894
Fulfilling the requirements of religious belief,	.100	-.799
Positive teacher	-.262	-.192

The homogeneity of variances was also examined to decide on the analysis method in the study. Levene statistics were used for homogeneity. According to the analysis results, the variances of the strategies of satisfying wishes and fulfilling the

requirements of religious belief are not homogeneously distributed according to positive teacher characteristics. It was concluded that other variables were homogeneously distributed (Table 2). Based on these results, two dimensions were excluded from the study. With the remaining variables, it was concluded that parametric analysis methods should be used. In the analysis of the data, descriptive statistics, correlation analysis and regression analysis were used.

Table-2 Homogeneity test results

Dimensions	Levene statistics	p
Career plan	1.960	0.052
Career exploration	1.633	0.054
Reacting positively to the environment	0.994	.0.458
Rest the body	1.479	0.104
Satisfying desires	*2.114*	*0.005**
Happiness oriented behaviors	1.338	0.171
Mental control	1.060	0.395
To practice religious belief	*2.496*	*0.002**

Studying Group

This study was carried out with teachers who teach in various public secondary education institutions. A total of 238 teachers in 6 branches took part in the study. The branches of the teachers are Turkish Language and Literature (26), Mathematics (43), Physics (43), Chemistry (42), English (40) and Geography (44). 180 of the teachers are women and 58 of them are men. The ages of the teachers are between 24 and 50. Their average age is 32.07.

Measuring Tools

Positive Teacher Scale: The scale developed by Eryılmaz and Bek (2018) is a scale answered from teachers' perspectives. Although the scale is a five-point Likert-type scale consisting of 21 items, the items are answered as “1=Not at all, 2=Very little, 3=A little, 4=Mostly, 5=A lot”. The validity and reliability study was applied to 448 teachers, and as a result of this study, explanatory factor analysis was performed, and five sub-dimensions consisting of 20 items emerged. These; are "having an extrovert personality trait," "concretizing the subject," "establishing a positive relationship with the student," "involving the student in the lesson," and "making a flow in the lesson." In this study, which was evaluated over the total score, these factors explained 63,230% of the total variance. The scale's reliability was analyzed with the Cronbach Alpha technique, and the reliability value was found to be 0.89. It was also observed that the scale was adapted to the group to which it was applied by performing the confirmatory factor analysis (Eryılmaz & Bek, 2018).

Career Adaptability Scale: This scale was developed by Eryılmaz and Kara (2016). It has two dimensions: Career Discovery and Career Plan. Internal consistency, test-retest method, exploratory factor analysis, and construct validity studies were conducted by Eryılmaz and Kara (2016). The scale's reliability was determined by internal consistency and the test-retest method. The internal consistency coefficient of the career exploration sub-dimension of the scale was 0.84, the internal consistency coefficient of the career plan sub-dimension was 0.71, and the internal consistency coefficient of the whole scale was 0.85. The reliability coefficients made by the test-retest method were found to be 0.82 for career exploration and 0.87 for career planning. According to the exploratory factor analysis results, a two-dimensional scale with a total explained variance of 55.87% was obtained. The factor loads of this scale vary between 0.57 and 0.80. Confirmatory factor analysis was performed for construct validity. According to the analysis results, the RMSEA value of the two-dimensional scale was 0.071.

Strategies to Increase Happiness Scale: The reliability of the Adult Happiness Enhancing Strategies Scale was determined by the Cronbach Alpha internal consistency technique. Accordingly, the internal consistency coefficient of the sub-dimension responding positively to the environment was 0.84; the internal consistency coefficient of resting the body dimension was 0.83; the internal consistency coefficient of saturating requests sub-dimension was 0.69; the internal consistency coefficient of the dimension of exhibiting behaviors towards happiness directly is 0.81. The internal consistency coefficient of the mental control sub-dimension was found to be 0.83, and the internal consistency coefficient of the sub-dimension of fulfilling religious belief requirements was 0.83. The internal consistency coefficient of the entire scale was found to be 0.89. According to the confirmatory factor analysis results, the RMSEA value was 0.063, the Chi-square value was 599.79, and the degree of freedom was 335. The ratio obtained by dividing the chi-square value by the degrees of freedom was found to be 1.79.

FINDINGS

Descriptive Statistics

Table-3 Descriptive Statistics

Dimensions	x̄	Sd
Positive teacher total	87,60	8,84
Career plan	15,61	2,18
Career exploration	25,88	3,28
Reacting positively to the environment	19,06	3,21
Rest the body	17,80	4,41
Satisfying desires	*13,57*	*3,59*
Direct happiness behaviors	17,93	4,66
Mental control	18,05	3,40
To practice religious belief	*11,48*	*4,68*

Table-4 Correlation analysis results

Factors	1	2	3	4	5	6	7
1.Total positive teacher	-						
2.Career plan	.298**						
3.Career exploration	.471**	.475**					
4.Reacting positively to the environment	.388**	.227**	.335**				
5.Rest the body	.076	.188**	.158*	.028			
6.Behavior towards happiness directly	.410**	.154*	.309**	.347**	.333**		
7.Mental control	.368**	.156*	.276**	.418**	.373**	.513**	

*p<0.05; **p<0.05

According to the study findings, the career exploration dimension had the highest correlation with the total score of the positive teacher characteristics scale (r = 0.471; p<0.01). The second highest correlation between the positive teacher characteristics scale and the total score was the direct dimension of behavior towards happiness (r = 0.410; p<0.01). The scale of positive teacher characteristics yielded the third highest correlation with the total score, the dimension of reacting positively to the environment (r = 0.388; p<0.01). The fourth highest correlation with the positive teacher characteristics scale total score was the mental control dimension (r = 0.368; p<0.01). The career plan dimension gave the fifth highest correlation between the positive teacher characteristics scale and the total score (r = 0.298; p<0.01). A significant and significant relationship was not found between the total score of the positive teacher characteristics scale and the rest of the body dimension (r = .760; p<0.01).

Table-5 Regression analysis results

Factors	B	SeB	Beta	t	p
1.Constant	39.282	5.097		7.707	.00**
2.Career plan	.427	.274	.095	1.558	.12
3.Career exploration	.871	.190	.291	4.574	.00**
4.Reacting positively to the environment	.405	.190	.133	2.135	.03*
5.Rest the body	-.270	.133	-.121	-2.030	.04*
6.Behavior towards happiness directly	.471	.136	.223	3.454	.00**
7.Mental control	.428	.195	.148	2.195	.02**

*p<0.05; **p<0.05

According to the research findings, career adaptability and strategies to increase happiness significantly explain positive teacher characteristics (R=.59, R2 =.35, F=21.15, p<.00). Firstly, the positive teacher characteristics were explained at the highest level by career exploration (β= -.29; p= .00). Secondly, behavior towards happiness directly one of the strategies to increase happiness explains positive teacher characteristics (β= .22; p= .00). Thirdly, the cognitive control strategy one of the strategies to increase happiness explains the positive teacher characteristics (β= .14; p= .02). Fourthly, the strategy of reacting positively to the environment one of the strategies to increase happiness explains positive teacher characteristics (β= .13; p= .00). Finally, the rest the body strategy one of the strategies to increase happiness explains the positive teacher characteristics (β= -.12; p= .04).

DISCUSSION

Three of the strategies to increase happiness revealed positive teacher characteristics, and one of them revealed negatively significant. In this study, it was seen that positive teacher characteristics were positively related to the career exploration dimension of career adaptability. On the other hand, it was concluded that the relationship between career plans and positive teacher characteristics was not significant.

There is an increase in studies examining variables associated with positive teacher characteristics. For example, a study conducted in Iran found that positive teacher characteristics are also valid for Iranian culture (Dezaki, Nadi & Sajjadian, 2022). Another study examined the relationships between mindfulness-based teaching and positive teacher characteristics (Gördesli & Örnek, 2022). Similarly, another study investigated positive teacher characteristics to help students with learning difficulties (Oğuz et al., 2020). Despite all this, no study has been found that examines the relationships between the variables in this study and positive teacher characteristics. At this point, it can be said that this study contributed to the literature.

Teachers' career adaptability has been found to be related to self-efficacy and career optimism (McLennan, McIlveen & Perera, 2017), family effects and learning situations (McLennan et al., 2019). In the national literature, the career adaptability of teachers is related to personality traits (Eryılmaz & Kara, 2017), emotional intelligence and goal striving (Eryılmaz, Seller & Deniz, 2020), loneliness and burnout (Eryılmaz & Kara, 2021). However, no study examines the relationship between positive teacher characteristics and career adaptability. In general, it can be said that this study contributed to the literature in terms of showing the direction and strength of the relationship between these two variables.

Career adaptability was found to be associated with positive teacher characteristics. When an assessment is made in general, the increase in career adaptability means that teachers are adaptable to their profession. This increased adaptability can increase their motivation because the increase in the motivation of the teachers reflects positively on the students. Teachers with increased motivation also exhibit features such as motivating the student and making an effort for the student (Roeser et al., 2000). A positive teacher naturally contains these features.

The fact that positive teacher characteristics are positively related to the career exploration dimension of career adaptability can be addressed in many ways. The exploration dimension of career adaptability means that the person discovers himself and his profession (Eryılmaz & Kara, 2017; Stumpf, Colarelli & Hartman, 1983). Primarily, the teachers involved in this study are between the ages of 24 and 50. These teachers can experience self-exploration from many points compared to advanced adults. In addition, since new information is constantly being produced in the modern world, they have to experience exploration for their profession. In addition to all these, it can be said that being a positive teacher requires exploration to make students happy, help them learn, participate in the lesson and succeed. For all these reasons, positive teacher characteristics and career exploration may have been positively related in this study.

On the other hand, one of the critical reasons why the relationship between career plans and positive teacher characteristics is insignificant may be that the teaching profession is not considered a career profession so far in Turkey. Teachers are not expected to make plans in a profession with no career steps. In addition, positive teachers who love the teaching profession are not expected to have plans to turn to another profession.

The results of this study show that positive teachers' characteristics increase as they respond positively to the environment, act directly toward happiness, and perform mental control. This finding can be considered in terms of strategies to increase happiness. Using strategies to increase happiness generally makes individuals happy (Eryılmaz, 2014; Tkach & Lyubomirsky, 2006). Positive teachers are happier when they use these three strategies. These positive emotions may have activated their positive teacher characteristics. Because according to Expanding and Building Positive Emotions Theory, experiencing positive emotions frequently helps individuals to build their capacities and broaden their perspectives (Fredrickson, 2004). At this point, positive teacher characteristics can also be considered as capacities to be expanded and built.

One of this study's exciting findings is that as the body rest strategy increases, positive teacher characteristics decrease. At this point, positive teachers have to be active. When we look at the positive teacher characteristics, it is seen that the features such as engaging the student in the lesson, concretizing the lesson, establishing a positive relationship with the student, helping the student to experience flow and establishing positive relationships with students are essential (Eryılmaz & Bek, 2018). Bringing these features into life already requires being physically active. In addition, according to the philosophy of happiness, Aristotle states that happiness is not something one is exposed to and requires active effort (Eryılmaz, 2014). Being physically passive does not fit Aristotle's philosophy of happiness. Positive teachers seem to have adopted this philosophy.

This study has revealed the means of having positive teacher characteristics in one respect. At this point, it is necessary to develop positive teacher characteristics. In addition, teachers need to be effective teachers. Duckworth, Quinn, and Seligman

(2009) concluded that teachers' happiness would affect effective teacher behaviors. Increasing positive teacher characteristics using happiness-enhancing strategies can help teachers be both happy and effective. This study shows that the teaching profession should be a career profession. Conducting similar studies on positive teachers who practice their profession, especially in countries with career ladders, may help us see the relationship between career adaptability and positive teacher characteristics from a broader perspective. Because according to the results of their research, Tösten and Özgan (2017) concluded that teachers' positive perspective increases their school happiness. As a result of another study concluded that having a positive perspective is essential for teachers' self-actualization and happiness (Seligman & Csikszentmihalyi, 2000).

As a result, it is necessary to carry out the necessary vocational guidance studies for the students to choose the most suitable profession for their personality traits, starting from the pre-school period until the period when the choice of profession is expected. Let us think about this issue in the teaching profession. In that case, individuals who are suitable for the teaching profession and who have positive teaching characteristics will serve the teachers to use the strategies to increase happiness in a way that will have a positive effect on their subjective well-being.

Considering the results of the research, in-service training studies, psycho-educational studies, group guidance training studies and workshops that can improve the positive teaching characteristics of individuals should be planned and implemented. When the field writing studies conducted as a result of the research were evaluated, it was observed that the studies were few in quantity. New research results can be brought to the literature by investigating concepts such as "positive teacher, strategies to increase happiness and career adaptability," which are very important for the teaching profession, with different variables. In particular, according to the results determined as a result of the research, it will contribute to the experimental studies that will be made according to the needs of the society and school structure, sensitive to culture. It can be applied as a result of experimental studies, and training programs that serve functional teachers to perform their profession more qualified can be created.

Considering the research results, the suggestions deemed appropriate by the researchers are as follows. From the pre-school period until the period when the choice of profession is expected, the necessary vocational guidance studies should be carried out for the students to choose the most suitable profession for their characteristics. Suppose we think about this issue in the teaching profession. In that case, individuals who are suitable for the teaching profession and who have positive teaching characteristics will serve the teachers to use the strategies to increase happiness in a way that will have a positive effect on their subjective well-being. In addition, it has been concluded that career adaptability will be positively affected if teachers have the personality traits required by profession. As a result of the high career adaptability, the way for students to receive training from more qualified teachers will be paved. This is very important for educational activities to reach their goals.

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I/We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

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The study was conducted and reported with equal collaboration of the researchers.

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| Review Article / Derleme Makale |

How Do Adolescent Friendships End and How Do Adolescents Experience and Interpret This Development?

Ergenlerin Arkadaşlıkları Neden ve Nasıl Bozulur ve Ergenler Bu Durumu Nasıl Yaşar ve Yorumlarlar?

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Keywords

1. Adolescence
2. Friendship
3. Conflict
4. Conflict Resolution Skills
5. Reasons of Conflict

Anahtar Kelimeler

1. Ergenlik
2. Arkadaşlık
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Abstract

Friendships become much more important during adolescence. Although puberty leads to a more stable friendship by age, some adolescents maintain their friendships steadily, while others end their relationships in a short time. Despite the potential significance of friendship breakdowns, little is known about the nature of their dissolution. Since losing a friend, who is a source of both instrumental and emotional support for individuals, means losing an important person, it is important to evaluate why adolescents' friendships deteriorate and what happens in this process. The aim of this study is to deal with the conflict situation, which is one of the factors affecting the deterioration of adolescents' friendships. The rates of deterioration in friendships, especially close ones, indicate that many adolescents struggle with this challenging task. In this context; The importance of friendship for adolescents, its functions and loss of friendship, the development process of friendship and the maintenance of relationships, reasons for conflict, conflict resolution strategies and adolescents' experiences are mentioned. Concessions from important friendship obligations such as trust, betrayal, jealousy in other relationships, help and closeness in friendships of adolescents constitute the causes of conflict. This review study contributes to understanding the reasons for the deterioration of adolescents' friendship relations and the effects of this situation on adolescents.

Öz

Arkadaşlıklar, ergenlik döneminde çok daha önemli hale gelir. Yaş itibari ile ergenlik, arkadaşlığın daha istikrarlı olmasına yol açmasına rağmen ergenlerin bir kısmı arkadaşlıklarını istikrarlı bir şekilde devam ettirirken, bir kısmı ise ilişkilerini kısa sürede sonlandırır. Arkadaşlık bozulmaları, potansiyel önemine rağmen, çözülmesinin doğası hakkında çok az şey bilinmektedir. Bireyler için hem araçsal hem de duygusal destek kaynağı olan bir arkadaşı kaybetmek, önemli bir kişiyi kaybetmek anlamına geldiği için ergenlerin arkadaşlıklarının neden bozulduğu ve bu süreçte neler yaşandığının değerlendirilmesi önemlidir. Bu çalışmanın amacı, ergenlerin arkadaşlıklarının bozulmasını etkileyen unsurlardan biri olan çatışma durumunun ele alınmasıdır. Arkadaşlığın, özellikle yakın arkadaşlıkların bozulma oranları, birçok ergenin bu zorlu görevle mücadele ettiğini göstermektedir. Bu bağlamda; ergenler için arkadaşlığın önemi, işlevleri ve arkadaşlık kaybı, arkadaşlığın gelişim süreci ve ilişkilerin sürdürülmesi, çatışma nedenleri, çatışma çözme stratejileri ve ergenlerin yaşadıklarından bahsedilmiştir. Ergenlerin arkadaşlıklarında güven, ihanet, diğer ilişkileri kıskanma, yardım, yakınlık gibi önemli arkadaşlık yükümlülüklerinden taviz verilmesi çatışma nedenlerini oluşturmaktadır. Bu derleme çalışması, ergenlerin arkadaşlık ilişkilerinin bozulma nedenlerini ve bu durumun ergenler üzerindeki etkilerinin anlaşılmasına katkı sunmaktadır.

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INTRODUCTION

Friendships become more important in adolescence due to the increase in individuals' need for close relations (Sullivan, 1953) in adolescence (Legerski, 2010). Although friendship is a relatively fragile relationship (Poulin & Chan, 2010), in adolescence, friendships could be more stable (Berndt, 1986). The high friendship stability during adolescence is associated with the attributes of friendship and the friend. Specific significant attributes are the increase in selectivity, the increase in the qualitative attributes of friendship, and effective conflict resolution (Bukowski et al., 1996). Since friendship is essential for adolescents, the stability or deterioration of friendships could play a critical role in the development of adolescents, and the loss of friends is often a stressful experience and could be pretty traumatic. The end of a friendship does not only lead to negative emotional consequences but could also impair cognitive and behavioral functions (George, 1999).

The Significance and Functions of Friendship, and The Loss of a Friend

Harry Stack Sullivan (1953) provided a theoretical framework for the developmental significance of friendship during adolescence. Sullivan (1953) argued that development includes various stages (infancy, childhood, second childhood, pre-adolescence, adolescence, and adulthood), various interpersonal needs emerge at each stage of development, and certain relationships are more adequate to meet these needs, providing a developmental approach to social relations. According to Sullivan (1953), friendships become more important as children enter adolescence. The most important developmental changes experienced in friendships during adolescence include the increasing importance of reciprocity, trust, and emotional intimacy in relations (Bukowski et al., 1994; Darling et al., 2003; Parker & Asher, 1993). Although adolescents search for several things in friendships, they primarily seek trust. Safety and confidentiality are associated with the presence of a friend when needed, avoidance of backbiting and making fun of the friends (Azmitia et al., 1999). Similarly, Öztürk, Atli, and Şad (2021) described a good friend as someone who is perceived as a reliable, protective friend in need and for whom one is emotionally close, and a bad friend as someone unreliable jeopardizes one due to bad habits, a fair-weather friend, and emotionally distant. In brief, it was reported that adolescents value the presence and expression of social emotions, trust, and socialization in friendship equally; however, the possibility of conflict is usually high (Kuruzović, 2015).

Although the establishment and sustenance of friendships is a significant developmental task in adolescence, 25% - 50% of adolescents could not maintain friendships for various reasons during an academic year (Degirmencioğlu et al., 1998). A meta-analysis on the stability of friendships between the ages of 6 and 17 reported that only 50% of friendships remained stable (Meter & Cart, 2016). Bowker (2004) reported that about 30% of the best friendships among young adolescents end within six months. The deterioration and loss of friendship are significant for several reasons. The first is the various functions of friendship. It was reported that friendship is vital for mental development, and individuals without close friendships are at risk of mental health problems (Rutter, 1987). The satisfaction with friendships in adolescence demonstrates the significance of close friendships as a determinant of mental health outcomes (Kenny et al., 2013). Friendship contributes to the development of self-perception, allowing self-discovery and self-development of the individual (Sullivan, 1953) due to the feedback about the perceptions of others about the individual (Bagwell et al., 1998; Weiss & Smith, 1999).

Furthermore, it was reported that self-disclosure in friendship is valuable. Honest self-disclosure leads to particular beneficial advice (guidance component) in problem-solving, reducing anxiety and increasing the sense of self-worth (Sullivan, 1953); simple compliments from friends or congratulations after success could also have a positive effect on self-confidence (Bagci et al., 2014). Friendship promotes acceptance, understanding and trust (Erdly et al., 2001) and provides social support (Amichai-Hamburger et al., 2013; Prinstein et al., 2001). Second, losing a good friend could lead to emotional distress and confusion. Such experiences could also affect academic achievement and performance in extracurricular or other social activities (George, 1999). Related studies demonstrated that friendship promotes learning (Bukowski, 2001), plays a crucial role in academic participation and achievement (Brown et al., 2008), prevents school dropouts (Crosnoe et al., 2003), and leads to romantic relationships (Cohen, 2008). Third, the inability to maintain close and meaningful relationships with peers could profoundly affect an individual's expectations from future relationships. Problematic peer relationships may affect young individuals' romantic relationships and future relationships with colleagues (George, 1999). Thus, the deterioration or end of a relationship affects the lives of individuals. Disruptions in friendship may not only lead to distress and adjustment problems but could also have a significant impact on the individual's expectations about future friendships (George, 1999).

The Stages of Friendship and Maintenance of Relationships

Friendships begin when the parties meet and develop in a middle stage where solidarity and other attributes increase, decrease, fluctuate or remain constant. Sometimes, they end for various reasons. The first stage of friendship, the formation stage, includes the development of the friendship and the mutual relationship between the parties. The second stage, the maintenance stage, entails the reciprocity between the parties and their methods to remain together or change things. The final stage, dissolution, is the end of the friendship. The initial stage of friendship includes the recognition of or attraction to a potential friend, meeting a potential friend for the first time, getting to know the other individual, and allowing the other individual to get to know the other. The maintenance stage of the friendship is the most unstable period when the parties analyze the processes of closeness and intimacy and the extent to which the parties consciously participate in the relationship. Thus, friends evaluate one another, other friendships, friendship opportunities and associated social conditions consciously or unconsciously. For example, the parties may decide to end the friendship, keep it at the current solidarity level, or improve it to a higher or lower level of engagement.

These stages are influenced by cognitive and affective responses and behavioral events during the interaction. Cognitive processes reflect the parties' self-thoughts and thoughts about their friend and friendship. These considerations include analyses and judgments about the stability of the friendship, shared experiences, self-behavior, intentions or needs, and the other's attractiveness, personality, and similarities. Emotional processes include emotional responses associated with friendship. These reactions include positive emotions such as empathy, compassion, trust, loyalty, satisfaction, commitment, and joy and negative emotions such as indifference, anger, hostility and jealousy. Behaviors are the fundamental components of friendship. These behavioral processes include conflict, social support, collaboration and competition (Adams & Blieszner, 1994).

Since friendship is a relationship based on voluntarism and equality, dissolution could be experienced, and relationships are more likely to end, unlike permanent parent-child-sibling relationships (Flannery & Smith, 2021). Between the beginning and the end of the relationship, friends engage in behaviors to improve and sustain the friendship. These behaviors "maintain the relationship" and include various routines and strategic actions (Oswald et al., 2004). According to Bowker (2004), positive attributes are insufficient in friendships that end. According to Bagwell and Bukowski (2018), companionship, social support and reciprocity are essential for the sustenance of relationships.

Similarly, Rose and Serafica (1986) developed four typologies of care: intimacy, affection, interaction, and friendship self-care. Relevant studies demonstrated that various friendship attributes affect the stability of adolescent friendships. It was emphasized that high friendship quality attributes that include a high level of positive attributes (e.g., closeness, self-disclosure, prosocial behavior, Etc.) and low level of negative attributes (e.g., conflict, dominance, competition, etc.) predict friendship stability (Berndt, 2002; McChristian et al., 2012). It was also reported that the competencies required to sustain friendships in adolescence are different compared to those required to sustain friendships in childhood and more similar to the competencies required in adult relationships (Engels et al., 2001). Friendship competencies in adolescence include intimacy, bidirectional support, and conflict management (Burleson, 1995). The comparison of stable and unstable friendships revealed that unstable friendships have lower intimacy, closeness, and interaction levels and higher infidelity (Berndt et al., 1986). Similarly, Bigelow and La Gaipa (1980) argued that loyalty could promote stable adolescent friendships. Thus, the lack of these positive attributes could be the reason for the dissolution of a friendship (Flannery & Smith, 2021).

Differences between friends could be effective in the deterioration and dissolution of relationships. Although the friendships are based on similarities, similar friends are more likely to form stable friendships when compared to dissimilar ones (Hartl et al., 2015; Laursen, 2017). The areas of similarity could include demographics (age, gender, socio-economic level), reputation (popularity, academic achievements), personality, shared activities, attitudes and beliefs (Erdly et al., 2001, p. 8). Furthermore, third-party intervention could contribute to the dissolution of friendships between young individuals. While other peers could interfere with adolescent friendships (Parker et al., 2005), jealousy also affects friendship negatively (Öztürk & Atli, 2021). Furthermore, several environmental properties such as changing the class or no longer taking the same classes, changing schools (Flannery & Smith, 2021), mobility of the family (Bowker, 2011), and extracurricular groups and activities could also affect the stability of friendships (George, 1999).

The deterioration of friendship leads to different emotional reactions across individuals. The correlation between the deterioration of friendship and emotional responses could differ based on the triggers of the deterioration and the mode of the breakup. Emotional reactions to an ending friendship may vary based on the individual, the relationship and the duration. Anger and sadness are the two emotions studied to explain the deterioration of close relationships throughout life (Sbarra, 2006; Sbarra & Emery, 2005). In a study conducted on adolescents' reactions to the end of a friendship, Bowker (2011) argued that the participants most likely felt sad, followed by happiness and anger. The study emphasized the significance of the consideration of both negative and positive reactions to an ending friendship. It was also argued that ending the friendship will be beneficial when it is unhealthy and harmful for adolescents. It was reported in the literature that specific behavioral and psychological health problems could be "contagious," and individuals with such problems could develop these problems when they sustain certain friendships. For example, adolescents with friends, who engage in risky behaviors such as substance use, could develop such behavior (Flannery & Smith, 2017). Adolescents reported that their friendships ended due to conditions and felt less anger and guilt; however, their emotions were still less optimistic after the friendship ended (Flannery & Smith, 2021).

Conflict Resolution Strategies and Reasons of Conflict

Conflict is the most common reason for the deterioration of friendships (Flannery & Smith, 2021) and could also be experienced in supportive friendships (Murberg & Bru, 2004). Friends often experience more conflict when compared to ordinary relationships since they spend a lot of time together (Amichai-Hamburger et al, 2013), they care more about each other and desire the continuity of their friendship (Hartup, 1992). Conflict is a natural ingredient of social relations and could have both positive and negative effects on the quality and stability of a relationship (Bowker, 2004). Conflict could contribute to the reconstruction and development of adolescent friendships by re-establishing equality and intimacy in a friendship after a conflict by allowing the friends to redefine the boundaries and the expectations in the relationship (Hartup, 1992). The conflicts between adolescent friends could lead to the reevaluation of the relationship and expectations. Conflicts with friends, especially during adolescence, could strengthen the sense of identity and autonomy of the adolescents (Raffaelli 1997). Thus, friendships could end not due to the presence or absence of conflicts, but inadequate conflict management or conflict resolution strategies. It was reported that the frequency of conflicts between the friends may not be a problem, but the approaches adopted by the friends to resolve these conflicts could be more critical in the determination of the stability, and the employment of certain conflict resolution strategies

predicts stability (Bowker, 2004). Thus, conflict resolution is a skill employed in the establishment of stable and lasting friendships (Flannery & Smith, 2017), and an important friendship attribute (Ladd & Korchenderfer, 1996; Parker & Asher, 1993).

Different strategies are employed in conflicts between friends. Reconciliation strategies are associated with friendliness or neutrality during conflict, leading to the maintenance of friendship after the conflict. The separation strategies are associated with anger during the conflict, leading to either friendship or anger after the conflict. In a conflict, friends could adopt two types of actions; pressure/coercion or mitigation. Mitigation often requires reconciliation with consequences that facilitate interaction. Pressure/coercion, on the other hand, entails higher levels of angry and impulsive behavior, resulting in unequal and sometimes destructive outcomes, definitively ending the relationship (Laursen et al., 1996). Conflicts managed with reconciliation and mitigation are more constructive and could lead to more positive outcomes (e.g., sustenance of the friendship) when compared to the conflicts managed by coercion (Bowker, 2004). Conflicts where negative emotions and anger are dominant do not lead to reconciliation. Negative emotions and anger could inhibit reconciliation and mitigation (Dunn & Herrera, 1997). Socially anxious and shy individuals are more likely to alleviate conflict. Thus, anxious disposition plays a key role in reconciliation and alleviation of the conflict (Keltner & Potegal, 1998).

Since the consequences of destructive conflict entail anger and coercion/violence, close friends often tend to minimize or prevent the negative consequences of conflict. Since friends tend to prefer conflict resolution strategies that minimize the possibility of ending their relationship (Adams & Laursen, 2001; Laursen et al., 1996), these conflicts are mostly resolved quickly and amicably (Amichai-Hamburger et al., 2013). Adolescents develop several goals and strategies to resolve conflicts, and it was reported that close friends prefer reconciliation to repair a relationship (Adams & Laursen, 2001; Hartup, 1992). Thus, conflict resolution strategies constitute a significant component of friendship stability when compared to the conflict (Bowker, 2004).

During a conflict, both parties are concerned (for themselves and their partner) to a certain degree. In the avoidance (resentment) conflict resolution style, the level of self-concern and concern for the partner are low. In this conflict resolution strategy, individuals do not expect any benefit from the resolution of the conflict and therefore prefer resentment. Avoidance refers to attributes such as passivity, fear of confrontation, minimization of the significance of the conflict, and procrastination of the resolution. Avoidance could prevent a resolution between the partners (Rahim & Bonoma, 1979). In avoidance as a conflict resolution strategy, the individual responds to the conflict by not talking, resenting the other individual, and ignoring others (McKenna & Richardson, 1995).

Avoidance/resentment is an unhealthy form of communication, it impoverishes the environment of interaction. Resentment is a passive conflict. İndividuals who are parties to this passive conflict most likely experience an internal conflict. In passive conflict, the individual could internalize the anger (Dökmen, 1994, p.52). The suppression of anger could lead to passive aggressive behavior such as pouting and embarrassment (Healy, 2015). For example, the individual who started a passive conflict via resentment could experience an rapprochement-avoidance conflict: “Should I make peace? Should I not reconcile?" In this case, the first step in a passive conflict should be to resolve the internal conflict (Dökmen, 1994). Resentment could satisfy certain psychological needs. The root factor in resentment could be craving for "attention". Certain resentment is actually a call for friendship. Because although we try to give the message that "I do not care " to individuals we resent, this is actually the opposite or our emotions (Dökmen, 1994). Sometimes, the resentment in a relationship generally hopes and waits for this resentment to go away. It was reported that most of the problems and resentment among friends are caused by the personality traits of the individuals or the mistakes in the friendship (Healy, 2015).

In general, adolescents tend to reconcile to avoid harming their friendships in certain cases (Laursen, 1993). Reconciliation is the restoration of a long-standing relationship by ending a conflict (Butovskaya & Kozintsev, 1999). Reconciliation is a radical change where an intimate and personal relationship is renewed or repaired. In other words, it is “rebuilding a relationship that existed and then ended” (Martin, 1981). Fincham (2000) reported that reconciliation “entails restoring breached trust and requires the goodwill of both parties”.

Reconciliation entails rebuilding a close relationship after disagreement due to actual or perceived mistakes. The most prominent attributes of a conflict often include strong anger, resentment, suspicion and distrust. Reconciliation could be described as the reconstruction of trust. Since reconciliation is a disagreement that undermines the trust between the parties, it especially complicates the trust of the injured party for the perpetrator. The trust among close friends should be deep and strong enough to allow for self-disclosure and privacy. Reconciliation entails rebuilding the trust required in an intimate relationship. Intimate relationships entail intimacy, frequent meetings and self-disclosure. These relationships require strong trust, the components of which include the assurance of acceptance and love, the expectation of honesty, loyalty, care, and intimacy. Infidelity and betrayal could damage and end close friendships. In this case, reconciliation requires the partners to meet and express their emotions and apologies, reflecting their sadness and/or forgiveness (Govier & Verwoerd, 2002). Certain attributes of forgiveness could advance the reconciliation process. These halt the cycle of revenge, protect the victim, and acknowledge the past; forgiveness is essentially future-oriented and therefore offers an opportunity to repair damaged relationships (Noor, Brown, Gonzalez, Manzi & Lewis, 2008). For forgiveness, the party who states guilt could apologize and state that she/he would not do the same again. Accepting the wrongdoing, taking responsibility, expressing regret, and taking the initiative to rebuild the relationship could help repair the damaged friendship. If the other party trusts that the person at fault is sincere and x apologized for forgiveness, by apologizing, the party stating that he/she did wrong can state that he/she is sorry for his/her wrongdoing and will not do such a thing again. Accepting wrongdoing, taking responsibility, expressing regret, and taking the initiative to rebuild the relationship help repair the

damaged friendship. If the other party trusts that the person at fault has sincerely and sincerely apologized, it would accept the apology. When there is trust between individuals, they try to rebuild the close relationship that could be sustained (Govier & Verwoerd, 2002).

Oswald et al. (2004) emphasized that positivity, supportiveness, openness and interaction are key factors in resolving friendship problems. It was determined that reparative behavior vary based on the status of the friendship (best, close or ordinary), and best friends adopt more reparative behavior when compared to close or regular friends. Furthermore, for satisfying and stable friendships, both parties should participate in mutual reparative behavior. According to Tsang, McCullough, and Fincham (2006), reparation of a relationship emphasizes the behavioral component of reconciliation, while intimacy and commitment emphasize the psychological component. Thus, closeness and commitment in the sustenance or termination of the friendship are closely associated with the reconciliation strategy.

In the reconciliation conflict resolution strategy, the individual feels moderate self-anxiety and anxiety about the partner. Individuals who adopt this conflict resolution strategy engage in behavior that could meet their needs by resolving the conflict. Their approach is based on mutual “give and take” to reduce inequalities, show flexibility and sensibility, and reach a “midway” solution (Rahim & Bonoma, 1979). Those who feel deep sadness after a conflict are more likely to reconcile (Potegal & Davidson, 1997). Furthermore, the intent to sustain the relationship in the long term is an important predictor of the conflict resolution strategy. Friends are less likely to adopt incompatible conflict resolution strategies such as coercion and resentment in long-term relationships. Thus, it was emphasized that conflicts between friends could be resolved when both partners value the sustenance of the relationship (Amichai-Hamburger et al., 2013). In other words, friends who invest more in a relationship act to minimize their losses (Bowker, 2004; Hartup, 1992).

Individual differences are observed in the reconciliation behavior of adolescents in friendship conflicts. While certain adolescents spend significant effort to fulfill their friends' desires, others do not. It was reported that early life experiences could be effective in the development of this difference in behavior. In families that employ conflict resolution strategies that empathize with the perspectives and needs of others, 3-4-year-olds are more likely to resolve friendship conflicts by reconciliation or by emphasizing the desires or goals of the other party. Also, those who empathize with the emotions of their partner after a conflict are more likely to reconcile. It was reported that since females are more likely to display constructive behavior when compared to males in conflict, they prefer to talk about the problem, withdraw, and exhibit adaptive behavior (Ayas, et al., 2010; De Wied et al., 2007). The employment of passive strategies by females in conflict and their attempt to alleviate the conflict generally mean that females are more anxious to sustain the relationship when compared to males (Dunn & Herrera, 1997). Although there are only a few studies conducted with adolescents on gender-based differences in conflict resolution strategies, it was observed that these studies reported conflicting findings, especially on the employment of coercive strategies (De Wied et al., 2007, p.50). According to Yavuzer et al. (2013), adolescent males exhibit more aggressive behavior in conflict when compared to females, while females tend to solve the problems. Similarly, Öztürk's (2020) reported that male adolescents resort to verbal or physical violence more often than girls in friendship conflicts. In contrast of the findings of that study, others reported that girls and boys adopt coercive strategies equally (Owens et al., 2005), or female adolescents resort to coercive strategies more (Feldman & Gowen, 1998). These conflicting findings were associated with the nature of the investigated conflicts and the employment of different measurement instruments. Furthermore, individuals may exhibit different emotional reactions to ending friendships based on gender. Females tend to internalize negative emotions in the form of sadness, fear, or anxiety, and males tend to express negative emotions in the form of anger and aggression (George, 1999). Highly instable friendships were associated with internalization problems (Chan & Poulin, 2009). In a study conducted with 5th, 6th, and 9th grade students, Rose, Click & Smith (2011) determined that those suffering from depression experienced less stable and low-quality friendships and more conflicts. The impact of friendship dissolution could be cumulative, and the more disruptions adolescents experience in friendships, the more likely they experience unconformity (Flannery & Smith, 2021).

Conflicts between friends often arise due to different or incompatible needs, goals, or expectations (Fisher, 2000). Inconsistencies between the expected and actual behavior could lead to the feelings of anger and conflict in the relationship. Factors such as trust, betrayal, envy of other relationships (Sheets & Lugar, 2005), compromise of significant friendship obligations such as assistance and intimacy (Laursen et al., 1996) could lead to conflict. It was also observed that friendships between females are more likely to be disrupted by third-party-oriented problems when compared to males, and when a third party is involved in a friendship, the friendships between females are disrupted due to jealousy (of other relationships) (George, 1999, p.13).

Studies on the Nature of Friendship

The reports by Adams and Laursen (2001) revealed that conflicts between friends are mostly the products of the problems associated with the relationship. According to Laursen et al. (1996), relationship problems are observed when friends disagree on the equal distribution of acquisitions in a relationship. Thus, conflict indicates the presence of a perceived unequal relationship, that is, a state of imbalance between the interactional rewards and costs.

In a study on pre-adolescents, Azmitia et al. (1999) determined that conflicts, events beyond the control of the individual, such as transfer to a new classroom, school, neighborhood or city, or friendship expectations, such as different interests, affect stability. Conflict is behind the termination or dissolution of 38% of friendships in pre-adolescence. Factors beyond the parties' control, such as transfer to a new class, school, neighborhood or city, or different interests affect the termination and dissolution of 24%

of the friendships, distrust affects 21%, exclusion affects 6%, and noncooperation affects 2%. Participants believed that best friendships end when best friends cease to be pleasant individuals. In that study, it was reported that conflict had the most significant share in the termination of friendships.

George (1999) reported that friendships among 6th-grade students significantly deteriorated over 14 weeks. Based on the friendship rating of the participants, 43% of those who were good friends in the winter were no longer good friends in the spring. It was determined that most friendships ended during the academic year. The probability of not losing a best friend was the same for both male and female children. However, the females said they did their best not to lose their best friends.

Büyükşahin-Çevik and Atıcı (2008) reported that the issues of conflict experienced by high school adolescents with their friends included “differing worldviews,” “different ideas about their friends,” “decisions on places to visit,” “different views on opposite sex friendship,” “interference in friendships with the opposite sex,” and “different clothing styles.”

Sarıpınar (2014) determined that the solution strategies adopted by the students in the management of the conflicts with their peers included "democratic solution," followed by "domination" when the first was not successful, and "avoidance."

In a study by Kuruzović (2015) conducted with 14-15 years old adolescents, it was reported that the intimacy and conflict levels were higher in shorter friendships, those who tend to have shorter friendships changed friends frequently, and females experienced higher levels of love, interaction, closeness and conflict in their friendships. The study determined that independent of the high conflict scores among females, conflict was important for both genders in this age group.

According to Kızıloluk and Uğurlu (2017), the most prominent factors that lead to friendship conflicts were self-interest and deception. Disrespect and disagreement were the other significant factors. The overall analysis of the study findings revealed that deception was a more significant cause of conflict when compared to the other factors. It was observed that the factors that affect the sustenance of friendship included respect (f=9), followed by trust (f=8), self-sacrifice (f=5) and tolerance (f=5).

In a qualitative study conducted by Öztürk and Atli (2021) with 90 (45 female and 45 male) 15-18 years old high school students, resentment behavior adopted as a passive conflict resolution strategy was investigated. The study provided a deep understanding of the emotions and experiences of adolescents who were resentful due to friendship conflicts. It demonstrated that the reasons behind resentment included jealousy of close friends, smack talk by friends and sharing private information with others, disagreement about activities, romantic relationship conflicts, and bad jokes. The analysis of the correlation between resentment reasons and gender revealed that females were more offended by jealousy, gossip and sharing secrets. At the same time, males were more offended by conflicts about activities. There was no difference between resentment due to rude behavior and pranks in romantic relationships based on gender. The study by İlleez (2006) reported that the most frequently adopted conflict resolution strategy among 11-12-year-old students was resentment (70%).

Flannery and Smith (2021) reported that 86% of adolescents commonly experienced deterioration in friendships. It was determined that conflict was the most common reason for the termination of friendships. Lack of social support is the second most frequently reported reason for the termination of friendships, and the parent's interference with the children's friendships was the third common reason. Adolescents experienced mixed emotions, including sadness and happiness/relief after the termination of friendships. More males reported happiness/relaxation after the end of the relationship compared to females. It was observed that adolescents whose friendships deteriorated more experienced higher levels of depression.

CONCLUSION AND RECOMMENDATIONS

Most research focused on the termination of adult relationships—usually the termination of romantic relationships and close friendships. Although disruption and termination in close relationships such as parent-child, marital, and friend loss in adolescence are a source of great concern, research on the loss of friendships in adolescence is almost non-existent (Bukowski et al., 1996; George, 1999, p.5; Thayer et al., 2008). Thus, it is essential to conduct studies that would contribute to understanding the factors that ensure the stability of adolescent friendships and the reasons behind the deterioration of these relations.

Studies on adolescent friendships reported a positive correlation between friendship quality and stability (Berndt, 2002; Branje et al., 2007; Bukowski et al., 1994; McChristian et al., 2012). Furthermore, conflict and conflict resolution strategies, the components of friendship quality, are essential factors in both short-term and long-term friendships (Thayer et al., 2008). Studies demonstrated that conflict resolution skills were associated with the sustenance/stability of friendships in adolescence. Since conflicts are considered a potential threat to friendship, the approach of adolescents to conflict resolution entails more attention and effort (Kuruzović (2015). Studies demonstrated that conflicts among adolescent friends stem from trust, betrayal, jealousy of other relationships, assistance and intimacy, romantic relationships, respect, dishonesty, and disagreement about activities. In conflicts, female adolescents prefer adaptive strategies and act constructively, while male adolescents tend to adopt coercive strategies. Females and males exhibit different emotional responses to the termination of friendships.

Studies reported that quality friendships positively affected adolescents, while conflicts between friends and the strategies adopted to resolve these conflicts could have a detrimental impact. The present literature review would contribute to the comprehension of the reasons that affect the deterioration of friendships between adolescents and associated conflicts and conflict resolution strategies. Furthermore, the study emphasized the differences in the reactions of adolescents to the

termination of friendships based on gender. The present literature review could help lay the groundwork for future studies on the termination of adolescent friendships and related coping strategies. Also, the current study demonstrated that adolescents require guidance on conflict and conflict resolution strategies, which are among the factors affecting friendships' deterioration and stability. Since friendship conflict and stress management skills still develop during childhood and adolescence (Benner, Hou & Jackson, 2020), school counselors should conduct group counseling and psycho-educational activities on conflict and conflict resolution strategies with adolescents. Also, school counselors could contribute to the sustainability of adolescent friendships by implementing psycho-educational programs that aim to improve adolescent friendships at schools and support the development of students with disabilities.

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We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

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Since this is a compilation study, ethics committee approval is not required.

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| Research Article / Araştırma Makalesi |

Analysis of the Mathematics Questions in 2021 High School Entrance Exam According to Learning Areas and the MATH Taxonomy

2021 Liselere Giriş Sınavı (LGS) Matematik Sorularının Öğrenme Alanlarına ve MATH Taksonomisine Göre Analizi

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Keywords
1.Mathematics Education
2.MATH Taxonomy
3.Learning area
4.High School Entrance Exam (LGS)

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Abstract

Purpose: The study was carried out to examine the mathematics questions in the 2021 High School Entrance Exam (LGS) regarding learning areas and the MATH Taxonomy's groups and categories for cognitive processes. In addition, math questions in 2018, 2019, and 2021 LGS were compared based on learning areas and MATH taxonomy.

Design/Methodology/Approach: Learning areas were coded as "learning areas" and "linked learning areas." In the context of cognitive processes, the exam questions were classified according to the groups and categories of the MATH Taxonomy developed explicitly for mathematics. The research was designed as document analysis, one of the qualitative research designs.

Findings: It was found that the questions in 2021 LGS were taken from all learning areas of secondary school mathematics and the number of questions was compatible with the learning areas in the curriculum. It was seen that many questions addressed more than one learning area, and the learning areas were related to each other. When the questions in 2021 LGS were examined in the context of cognitive processes according to the MATH taxonomy, it was found that there were questions from groups B and C, mostly C, and no questions from group A. The questions in 2018, 2019, and 2021 LGS were also compared in this study. It was found that the learning areas generally had a similar distribution, and when compared in terms of MATH taxonomy, the questions' level increased as the years progressed.

Highlights: MATH Taxonomy, explicitly developed for mathematics, is vital in examining mathematics questions according to cognitive processes. It was observed that the questions were not directed to a single learning area and that the learning areas were related to each other. Coding in the form of a learning area-linked learning area is essential.

Öz

Çalışmanın amacı: Bu çalışma, 2021 Lise Giriş Sınavında (LGS) yer alan matematik sorularının öğrenme alanları ve MATH Taksonomisinin bilişsel süreçlere yönelik grupları ve kategorileri açısından incelenmesi amacıyla yapılmıştır. Ayrıca 2018, 2019 ve 2021 LGS'de yer alan matematik soruları öğrenme alanları ve MATH taksonomiye dayalı olarak karşılaştırılmıştır.

Materyal ve Yöntem: Öğrenme alanları "öğrenme alanı" ve "bağlantılı öğrenme alanı" olarak kodlanmıştır. Bilişsel süreçler bağlamında, sınav soruları matematik için özel olarak geliştirilen MATH Taksonomisinin gruplarına ve kategorilerine göre sınıflandırılmıştır. Araştırma nitel araştırma desenlerinden doküman incelemesine dayalı olarak yürütülmüştür.

Bulgular: 2021 LGS'deki soruların ortaokul matematiğinin tüm öğrenme alanlarından alındığı ve soru sayılarının öğretim programındaki öğrenme alanları ile uyumlu olduğu tespit edilmiştir. Birçok sorunun birden fazla öğrenme alanına hitap ettiği, öğrenme alanlarının birbiriyle ilişkili olduğu görülmüştür. 2021 LGS'de yer alan sorular MATH taksonomisine göre bilişsel süreçler bağlamında incelendiğinde, B ve C gruplarından çoğunlukla C olmak üzere soruların olduğu, A grubundan ise hiç soru bulunmadığı tespit edilmiştir. Bu çalışmada 2018, 2019 ve 2021 LGS arasında karşılaştırma da yapılmış olup, öğrenme alanlarının genel olarak benzer bir dağılıma sahip olduğu; MATH taksonomisi açısından karşılaştırıldığında ise yıllar geçtikçe soruların seviyesinin arttığı sonucuna ulaşılmıştır.

Önemli Vurgular: Matematik sorularının bilişsel süreçlere göre incelenmesinde matematiğe özel olarak geliştirilen MATH Taksonomi kullanımının önemli bir rolü vardır. Soruların tek bir öğrenme alanına yönelik olmadığı, öğrenme alanlarının birbiri ile ilişkili olduğu görülmüştür. Öğrenme alanı-ilişkili öğrenme alanı şeklindeki kodlamanın önemli olduğu düşünülmektedir.

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INTRODUCTION

In order to measure how many education and training goals are reached, it is necessary to measure and evaluate the behavioral changes in students (Baykul, 2000). The National Council of Teachers of Mathematics (NCTM, 2000) defines evaluation as a tool for improving students' learning and a valuable tool for making teaching decisions. The evaluation process is monitored by computer programs and by executive controls on individuals (Woolfolk, 1993).

Evaluation can be formative and summative. Formative evaluation is a planned process designed to constantly check students' comprehension of educational activities (Popham, 2008). On the other hand, summative evaluations are cumulative assessments that produce a specific score, such as final exams or standardized tests. In sum, while summative evaluation gives a snapshot of what the student knows at a particular moment, formative assessment is like a movie that presents the active status of the student's thinking and reasoning.

The measurement and evaluation process has a significant role in monitoring, controlling, and improving the functioning of an education system (Demirel, 2006). Measurement and evaluation are essential for education in measuring the students' success and the functioning of the teaching methods (Ministry of National Education, 2018). In mathematics teaching, measurement and evaluation contribute to determining the targeted learning outcome level, revealing misconceptions, and increasing performance (Alkan, 2008). Exams are the primary measurement tools used in determining these characteristics of the education system in Turkey. In Turkey, the measurement and evaluation process is carried out in two ways, locally and centrally (Çepni et al., 2003).

The Ministry of National Education and OSYM (Student Selection and Placement Center) conducts the central assessment and evaluation process to place students in a higher education institution. Until 1997, the exams were offered as OGES (transition system to secondary education institutions). These exams were offered under different names over the years to the students for the transition from secondary school to high schools, such as Secondary Education Institutions Exam (OKS) until 2009, the Placement Exam (SBS) until 2013, and the Exam for Transition from Basic to Secondary Education (TEOG) until 2017. The High School Entrance Exam (LGS) has been used since 2018.

The quality of the questions is essential for the central exams to be successful. The variations in the cognitive levels of the questions are the leading factor affecting this quality. Bloom's Taxonomy is the most widely used taxonomy to determine the cognitive level (Bloom, 1956). According to Bloom's taxonomy, mental development consists of the following six levels, from simple to complex: knowledge, comprehension, application, analysis, synthesis, and evaluation (Tan & Erdoğan, 2004). Bloom's taxonomy was updated under "Revised Bloom's Taxonomy" to address the deficiencies in taxonomy and meet the needs of developing education programs. In the revised taxonomy, the levels "evaluation" and "synthesis" changed places, and the hierarchy between all the levels was removed. Although Bloom's taxonomy can be used in any field, Smith et al. (1996) developed a new taxonomy only for the mathematics course using an approach different from that of Bloom. This taxonomy is the Mathematical Assessment Task Hierarchy (MATH) (Smith et al., 1996). The MATH taxonomy was developed to correctly classify the mathematical questions and test the skills and concepts (Smith, 2010). The MATH taxonomy supports deep learning and enables us to understand whether students learn superficially or deeply. This can be realized by asking questions in line with the categories in the MATH taxonomy (Smith et al., 1996). The MATH taxonomy provides a control to determine whether the student's knowledge, skills, and abilities are measured (Wood et al., 2002). The evaluation focuses primarily on exams. While a narrow skill area is often measured in exams, the MATH taxonomy aims to broaden the skill areas assessed (Smith et al., 1996). A broader and deeper learning experience can be offered to students via the MATH taxonomy (Ball et al., 1998). The MATH taxonomy allows to determine the students' levels of mathematical knowledge and broaden their learning areas. Math taxonomy consists of three main groups and eight subcategories (Table 1).

Table 1. Groups and categories of each group in MATH Taxonomy

Group A	Group B	Group C
A1 - Factual Knowledge and Fact Systems	B1 - Information Transfer	C1 - Justifying and Interpreting
A2 - Comprehension	B2 - Application in New Situations	C2 - Implications, Conjectures, and Comparisons
A3 - Routine Procedures		C3 - Evaluation

Group A requires superficial learning, whereas groups B and C require deep learning (Wood et al., 2002).

Categories in Group A: A1 - Factual Knowledge and Fact Systems: This category includes remembering a formula, knowledge, or specific definition. A2 - Comprehension: This category includes recognizing the examples and counterexamples of an objective or function related to mathematics and comprehending the importance of symbols in formulas. A3 - Routine Procedures: This category includes the exercises, sample questions, and daily routine procedures done by students in the classroom.

Categories in Group B: B1 - Information Transfer: This category includes the ability to transform information from one format to another, from verbal to quantitative, from quantitative to verbal, and transform quantitative data to graphic one. B2 - Application in New Situations: This category refers to the ability to choose and apply appropriate methods or information in new situations.

Categories in Group C: C1 - Justifying and Interpreting: This category refers to the student's ability to justify or interpret a result given by someone else or reached by the student. C2 - Implications, Conjectures, and Comparisons: This category covers the student's ability to make conjectures and comparisons about a given situation or a situation found by the student, to justify or prove it, and to draw implications about it. C3 - Evaluation: This category refers to the ability to judge the value of data and materials given for a purpose based on specific criteria (D'Souza & Wood, 2003).

In this study, the groups and categories of the MATH taxonomy were referenced in determining the cognitive levels of the mathematics questions in LGS-2021.

Uğurel et al. (2012) analyzed the mathematics questions in OKS, SBS, and TIMSS using the framework of MATH taxonomy. They reported that the categories with the highest number of questions were B1 in SBS-6, A3 in SBS-7, B1 and A3 in SBS-8, B2 in OKS, and A3 in TIMSS. In their study examining the math questions in the 2013 Spring ALES (Academic Personnel and Postgraduate Education Entrance Exam) according to the MATH taxonomy, Aliustaoğlu and Tuna (2016) reported that the highest number of questions was from the category A3 in the Quantitative-1 Test and the category C2 in the Quantitative-2 Test. On the other hand, Esen (2018) examined the mathematics questions in ALES from 2006 to 2013 according to the groups and categories in the MATH taxonomy and the mathematics learning areas and asserted that the categories B1 and B2 had the highest number of questions and the group A had the least number of questions. İltuş (2019) used the MATH taxonomy to examine the mathematics questions in the Teaching Subject Matter Knowledge Test of KPSS (Public Personnel Selection Exam) since 2013 and reported that the majority of the questions were from the group A. Gürbüz (2021) analyzed the limit-continuity and derivative-integral questions in the university entrance exams in Turkey between 1966 and 2019 according to the MATH taxonomy and reported that the limit-continuity and derivative-integral questions were asked the most from the group A and the least from the group C.

Similar to the studies by İltuş (2019) and Gürbüz (2021), Aygün et al. (2016) examined 939 math questions in the 6th, seventh, and 8th-grade exams according to the MATH taxonomy. They asserted that the majority of the questions were from group A (routine procedures and basic skills), there were fewer questions from group B (higher-order thinking skills), and there were almost none from group C (the highest-order thinking skills). Moreover, Gürbüz (2021) asserted that, as the year progressed, a decrease was observed in the number of questions from group A and an increase in the number of questions from groups B and C.

In the study carried out by Erdoğan (2020), it was noted that the questions in the mathematics subtests of 2016-2017 TEOG were mostly from the category A3 (Routine Procedures) of the MATH taxonomy. Erdoğan (2020) also reported that the correct answers were mainly in group A and the least correct answers were in group C. In her master's thesis, Farımaz (2020) compared 2018 and 2019 LGS questions as cognitive processes according to the groups and categories of the MATH taxonomy and concluded that 2018-LGS contained the most questions from the category C2, while the 2019-LGS from the category B2. She also reported that in 2018-LGS, the percentage of the questions from group A was close to that of those from group C, and the percentage of the questions from group B was low. In 2019-LGS, the percentage of the questions from group B was the highest, followed by groups A and C, in order of percentage. As for the distribution of the questions by learning areas, it was reported that the 2018 LGS contained questions mainly from the learning area "Geometry and Measurement" and no questions from the learning area "Data Processing."

On the other hand, the 2019 LGS was reported to contain questions from all learning areas. When the literature was examined, some studies were related to using MATH taxonomy at the undergraduate level (Bennie, 2013; Blanco et al., 2009). This study also examined the textbooks according to the MATH taxonomy and reported that the 2017-2018 mathematics textbook included questions from category A1 and the 2018-2019 mathematics textbooks mostly from category A3. In addition, Wong and Kaur (2015) examined mathematics questions in Singapore secondary schools within the scope of the MATH taxonomy. At the end of the research, they concluded that the mathematics questions in secondary schools were mainly asked in group A and category A3 among group A. On the other hand, it was observed that fewer questions were asked from the groups B and C.

With the advent of twelve-year-compulsory education in the 2012-2013 academic year, the Ministry of National Education (MoNE) revised the mathematics curriculum (Evirgen, 2014). The objective of this revised curriculum was to make students gain skills in information and communication technologies, psychomotor and affective skills, and reasoning and mental skills (MoNE, 2013). This objective was pursued in the curriculum revised in the 2018-2019 academic year. The new curriculum was created to provide meaningful and permanent learning, enable the use of metacognitive skills, and design education within the framework of skills (MoNE, 2018). The Secondary School Mathematics Curriculum includes five learning areas: numbers and operations, algebra, geometry and measurement, data processing, and Probability. LGS covers only the questions from the 8th-grade mathematics. Topics of the learning areas in 8th-grade mathematics are as follows. i. Numbers and Operations: factors and multiples, exponential expressions, and square root expressions; ii. Algebra: algebraic expressions and identities, linear equations, and inequalities; iii. Geometry and Measurement: triangles, congruence and similarity, transformation geometry, and geometric bodies; iv. Data Processing: data analysis; and v. Probability: the Probability of occurrence of simple events.

At this grade, there are 52 learning outcomes in these learning areas, and the time allocated for them is 180-course hours. When the curriculum was analyzed in terms of the learning outcomes and the time allocated for them, their distribution was found to be as follows: Numbers and Operations (Learning outcome: 30.77%; Recommended time: 27.78%); Algebra (Learning outcome: 25%; Recommended time: 30.56%); Geometry and Measurement (Learning outcome: 30.77%; Recommended time: 28.33%); Data Processing (Learning outcome: 3.85%; Recommended time: 6.67%); Probability (Learning outcome: 9.62%; Recommended time: 6.67%) (MoNE, 2018).

Research Questions

Research Questions of the study are as follows:

1. What is the distribution of the math questions in 2021 LGS by learning areas?
2. What are the distributions of the math questions in 2018, 2019, and 2021 LGS by learning areas?
3. What is the distribution of the math questions in 2021 LGS by the groups and categories in the MATH taxonomy?
4. What are the distributions of the math questions in 2018, 2019, and 2021 LGS by the groups and categories in the MATH taxonomy?

Purpose of the Study

The purpose of this study was to analyze the math questions in 2021 LGS by the MATH taxonomy and learning areas and to compare the results with those of 2018 and 2019.

Significance of the Study

Exams are expected to include questions that measure different levels of thinking and serve their purpose (Aliustaoğlu & Tuna, 2016). The questions prepared for an exam should enable students to think at a higher level. The MATH taxonomy was designed for the field of mathematics education in order to develop high-order thinking skills (Dost et al., 2011). New-generation questions are asked in LGS (Atasoy, 2019; Ünal, 2019) to ensure a high-order mental process. In the present study, the new generation questions were analyzed using the MATH taxonomy and attempted to determine whether they involve a high-order mental process. Therefore, this study is essential for the exams to be prepared in the coming years. This study is also essential in providing information to LGS question writers, teachers, and students about the structure of new-generation questions. The learning areas examined the distribution of LGS questions in this study. By doing so, a tool was offered for curriculum writers to see the accordance of the exams with the curriculum. Moreover, the analyzes in this study include the place of questions in more than one learning area, which helps to see the relationship between learning areas.

Limitations and Assumptions of the Study

• The questions in the study are limited to those in 2021 LGS math exam.

• The study was limited to the groups and categories in the MATH taxonomy and the learning areas in the secondary school math curriculum.

• In LGS 2020, the questions were only from the learning outcomes of the 1st semester due to the onset of the COVID-19 pandemic; so, LGS 2020 was not included in the comparison.

• The questions in LGS 2018 and 2019 were classified based on Farımaz's (2020) master's thesis and compared with those in LGS 2021 in terms of learning areas.

METHOD

The document analysis method was used in this descriptive study to analyze the mathematics questions in the High School Entrance Exam (LGS), administered to 8th-grade students in 2021, according to the learning areas and cognitive processes. Document analysis is the examination and analysis of documents containing information about a phenomenon at hand (Yıldırım & Şimşek, 2013).

The research data consisted of the mathematics questions in the quantitative section of 2021 LGS. These questions were obtained from the web page of the General Directorate of Measurement, Evaluation, and Examination Services, Ministry of National Education. There were 20 “new generation questions” in the exam, and exam booklet A was used in the study.

In the study, the distribution of the questions was revealed according to the learning areas. Since the questions included more than one learning area, the coding was done as "learning area" and "linked learning area." The questions were examined regarding cognitive processes using the groups and categories in the MATH taxonomy. According to the reliability formula of Miles-Huberman (1994), the researchers’ opinions showed an agreement of 85%, 90%, and 85% in pairs. The researchers conducted joint studies on each coding that lacked a consensus, ultimately achieving a consensus.

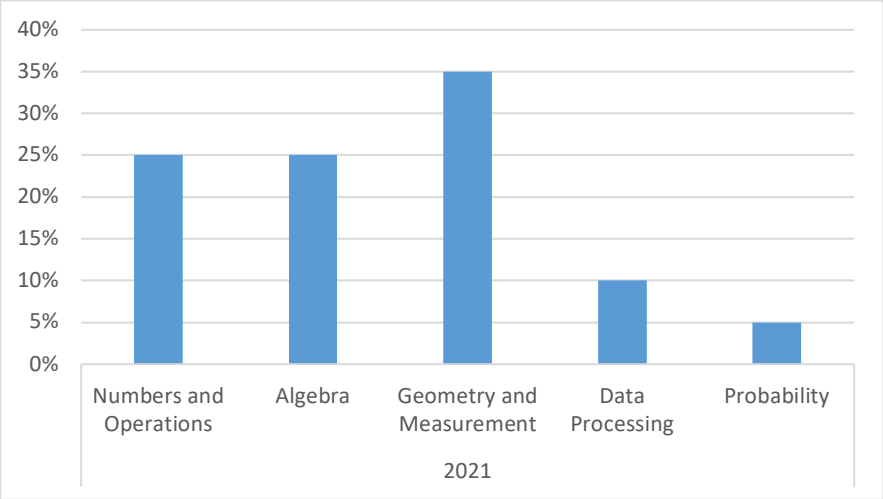
Since the research is based on document analysis, no ethics committee approval was required.

RESULTS

This part of the study presents the results obtained from the data of the study.

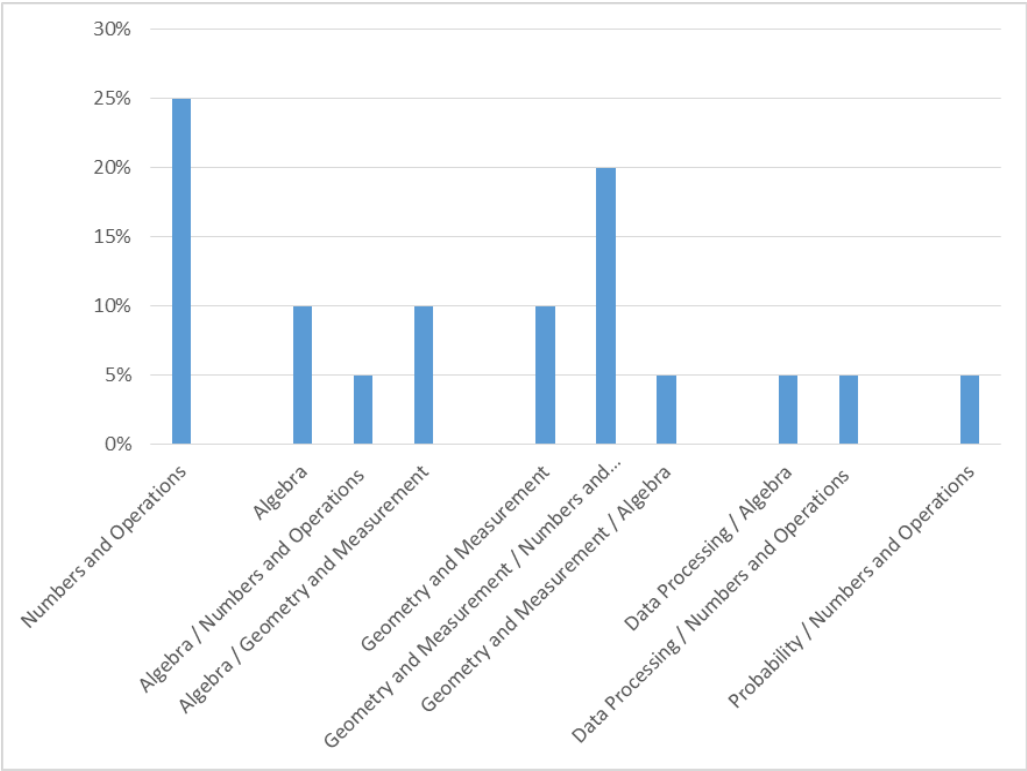
Analysis of the Data Associated with the First Sub-Question

Graph 1 shows the results for the first sub-question of the research, that is, “What is the distribution of the math questions in 2021 LGS by learning areas?”



Graph 1. Percentage distribution of the math questions in 2021 LGS by learning areas

As can be seen in Graph 1, the learning area “geometry and measurement” (35%) was found to have the highest number of questions in 2021-LGS, followed by “numbers and operations” (25%), “algebra” (25%), “data processing” (10%), and “probability” (5%). Graph 2 shows the distribution of the mathematics questions in 2021 LGS by learning areas and linked learning areas. If the question is directly related to a single learning area, it is coded with that learning area. However, if it was related to another learning area linked to a specified learning area, then it was coded with two learning areas.

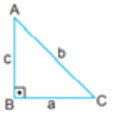
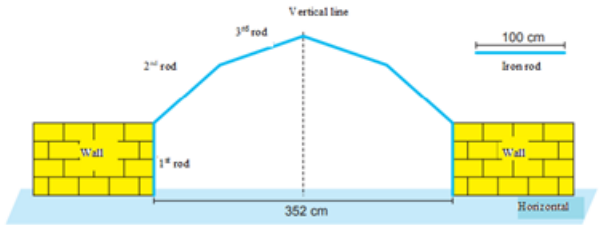


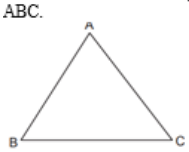
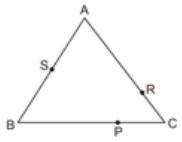
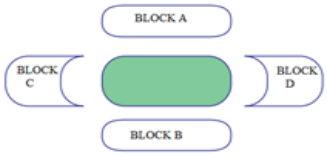
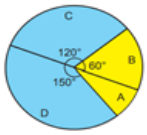
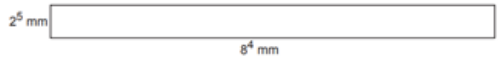
Graph 2. Percentage distribution of the math questions in 2021 LGS by learning areas and linked learning areas

In order to better understand the coding, Table 2 gives some examples of how the math questions in 2021 LGS were coded according to the learning areas and the linked learning areas. As seen in Graph 2, all the questions (25%) in the learning area “numbers and operations” were found to be directly related to this learning area alone. On the other hand, while some of the

questions in the learning area “algebra” (25%) were found to be directly related to this learning area alone (10%), some others were related to the learning areas “geometry and measurement” (10%) and “numbers and operations” (5%) as well as the learning area “algebra.” As for the learning area “geometry and measurement,” which had the highest number of questions (35%), some of the questions were found to be directly related to this learning area alone (10%). Most of them were related to the learning area “numbers and operations” (20%), and a minority of them to “algebra” (5%). Moreover, it was found that the questions in the learning area “data processing” (10%) were found to be related to the learning areas “algebra” (5%) and “numbers and operations” (5%), and the question in the learning area “probability” (5%) was found to be related to the learning area “numbers and operations” (5%).

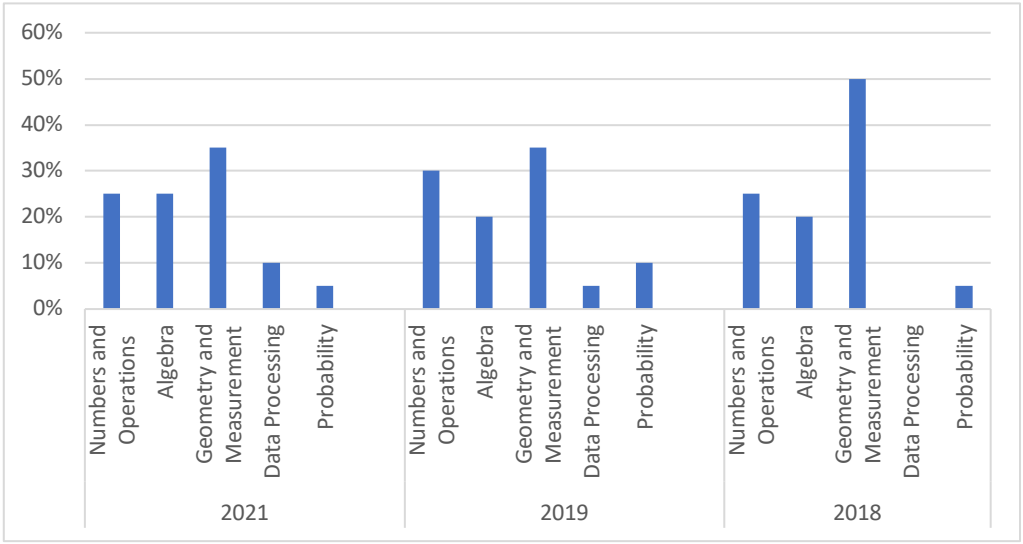
Table 2. Examples of coding and interpretation for the mathematics test questions in 2021 LGS according to the learning areas

Learning Areas	Linked Learning Areas	Explanations for the coding of learning areas	Sample Mathematics Questions from 2021 LGS (Translation)
Numbers and Operations		This question involves operations on exponential numbers; therefore, it was coded in the learning area “numbers and operations.”	a≠0 and m, n are integers. $a^n.a^m = a^{n+m}$ and $\frac{a^m}{a^n} = a^{m-n}$ In the table below, there are exponential numbers with a base of 2 and different exponents, and E and F are one of these numbers. Column I: 2^{-1} — Column II: 2^{-2} E: 2^3 — F: 2^1 The product of 3 exponential numbers in the Column I is equal to a perfect square positive integer and the product of those in the Column II is also equal to a perfect square positive integer. So, what is the least possible value of E + F? A) 33 B) 17 C) 9 D) 3
Algebra	Geometry and Measurement	This question asks the slope and requires the knowledge about Pythagorean theorem; therefore, it was coded in the learning areas “algebra” and the linked learning area “geometry and measurement.”	Slope is the ratio of the vertical length to the horizontal length. The hypotenuse of a right triangle is the side opposite the right angle. In a right triangle, the square of the length of the hypotenuse equals the sum of the squares of the lengths of the other two sides.  $a^2 + c^2 = b^2$ The gate of a park is modelled as follows.  In order to build the gate, 6 iron rods with a length of 100 cm will be spliced as seen in the model above. The length of the gate is 352 cm. The vertical line in the model splits the gate into two equal parts. The 1st rod is perpendicular to the surface. The 2nd rod has a slope of 75%. So, what is the slope of the 3rd rod? A) $\frac{7}{24}$ B) $\frac{3}{10}$ C) $\frac{5}{12}$ D) $\frac{1}{2}$

Learning Areas	Linked Learning Areas	Explanations for the coding of learning areas	Sample Mathematics Questions from 2021 LGS (Translation)
Geometry and Measurement		This question involves the triangle inequality; therefore, it was coded in the learning area "geometry and measurement."	Efe will use an inelastic rope to put in order the angle measures of the triangle ABC.  When Efe puts one end of the rope on; • the corner A and superpose it on [AB] and [BC], the other end of the rope reaches P, • the corner B and superpose it on [BC] and [CA], the other end of the rope reaches R, • the corner C and superpose it on [CA] and [AB], the other end of the rope reaches S,  If BP > AS> CR, what is the correct order of the internal angle measures of the triangle ABC? A) $m(\hat{A}) > m(\hat{C}) > m(\hat{B})$ B) $m(\hat{B}) > m(\hat{C}) > m(\hat{A})$ C) $m(\hat{C}) > m(\hat{B}) > m(\hat{A})$ D) $m(\hat{A}) > m(\hat{B}) > m(\hat{C})$
Data Processing	Algebra	This question involves the ability to interpret tables and circle graphics and use algebra; therefore, it was coded in the learning area "data processing" and the linked learning area "algebra."	 The figure above is the seating plan of a stadium. 80% of the tickets of the match is sold. The table below shows the ticket prices for each block, and the graph below shows the distribution of the unsold tickets by block. **Table**: Ticket Prices by Block Blocks / Price of one ticket (TL): A 20; B 20; C 10; D 10 **Graph**: Distribution of the unsold tickets by block  If the total price of the unsold tickets is 15000 TL, what is the number of tickets put up for sale for this match? A) 5000 B) 6000 C) 7200 D) 8400
Probability	Numbers and Operations	This question involves the ability to calculate probability and use the exponential numbers; therefore, it was coded in the learning area "probability" and the linked learning area "numbers and operations."	$a \neq 0$ and m, n are integers. $\frac{a^m}{a^n} = a^{m-n}$ and $(a^n)^m = a^{n.m}$ **Probability of occurrence of an event = the number of favorable outcomes / the total number of possible outcomes** The figure below shows a rectangular cardboard with the lengths of 2^5 and 8^4.  This cardboard is cut into equal squares with a length of 2^5 and colored in yellow, red, blue, green, and orange in a pattern. Then, all the square cardboards are put in a bag.  What is the probability that a randomly selected square cardboard is red? A) $\frac{25}{128}$ B) $\frac{1}{5}$ C) $\frac{13}{64}$ D) $\frac{7}{32}$

Analysis of the Data Associated with the Second Sub-Question

Graph 3 shows the results for the second sub-question of the research, that is, "What are the distributions of the math questions in 2018, 2019, and 2021 LGS by learning areas?"

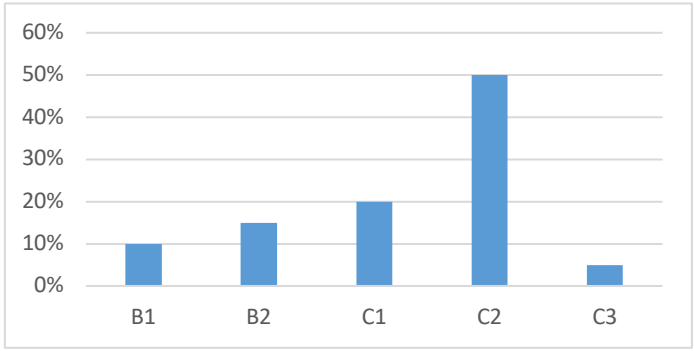


Graph 3. Distributions of the math questions in 2018, 2019, and 2021 LGS by learning areas

As can be seen in Graph 3, the learning area "geometry and measurement" was found to have the highest number of questions in 2018, 2019, and 2021 with 50%, 35%, and 35%, respectively. This learning area was followed by "numbers and operations" and "algebra." While the percentage of the questions from the learning area "numbers and operations" in 2019 was slightly higher than that in 2019 and equal to that in 2021. The learning areas "data processing" and "probability" were found to have the least number of questions. No questions were asked from the learning area "data processing" in 2018, and its percentage was low in 2019 and 2021 (5% and 10%, respectively). Similarly, the percentage of the learning area "probability" was also low in 2018, 2019, and 2021 (5%, 10%, and 5%, respectively).

Analysis of the Data Associated with the Third Sub-Question

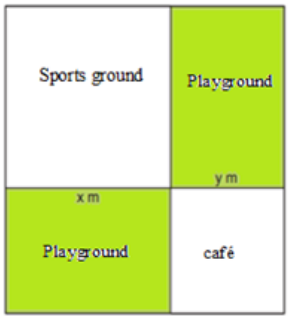
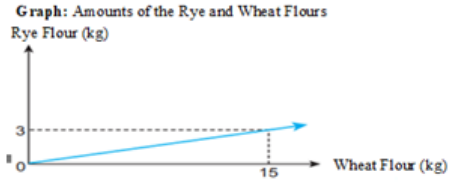
Graph 4 shows the results for the third sub-question of the research, that is, "What is the distribution of the math questions in 2021 LGS by the groups and categories in the MATH taxonomy?"

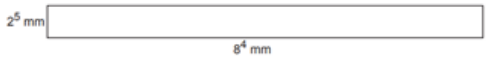
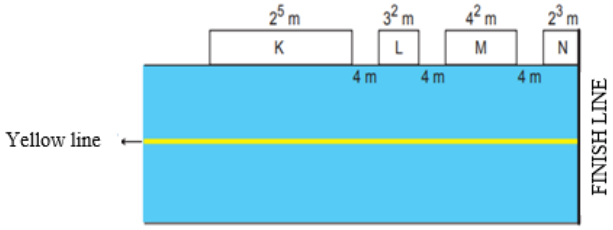


Graph 4. Distribution of the math questions in 2021 LGS by the categories of MATH taxonomy

As can be seen in the Graph 4, the math questions in 2021 LGS were mostly from the category C2 (50%), followed by the categories C1 (20%), B2 (15%), B1 (10%), and C3 (5%). There were no questions from the category A. In order to better understand the coding, Table 3 gives some examples of how the math questions in 2021 LGS were coded according to the groups and categories in the MATH taxonomy.

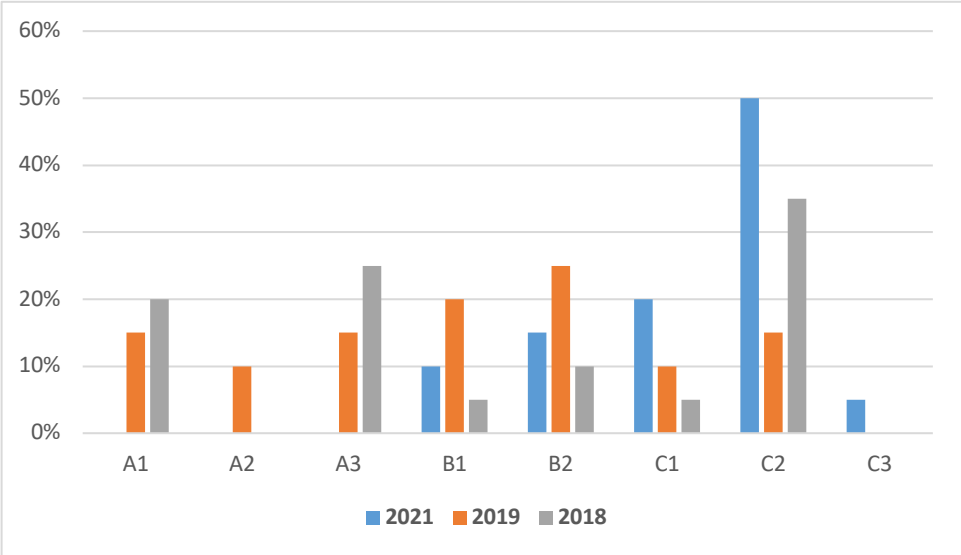
Table 3. Examples of coding and interpretation for the mathematics test questions in 2021 LGS according to the MATH Taxonomy

The Math Questions in 2021 LGS (Translation)	MATH Taxonomy Category	Explanation for Coding
The figure below shows a square plot. A square part (with a length of x m) of this plot is planned as a sports ground, and another square part (with a length of y m) is planned as a café. The remaining parts are left for playground.  So, what is the algebraic expression in m^2 for the sum of the areas of the parts left for playground? A) xy B) 2xy C) 3xy D) 4xy	B1 - Information Transfer	This question requires the ability to transform the model into algebra (Transforming information from one form to another)
In a bakery, a mixture of rye flour and wheat flour is used to bake bread. The graph below shows the linear relationship between the amounts of the rye and wheat flours in this mix. **Graph:** Amounts of the Rye and Wheat Flours  The rye and wheat flours were confused with one another and a mixture of 120 kg was prepared. Only wheat flour will be added to the mixture in order to correct this mistake and ensure a linear relationship between the amounts of rye and wheat flours shown in the graph. So, how many kilograms of wheat flour should be added to the mixture? A) 120 B) 380 C) 480 D) 520	B2 - Application in New Situations	This question asks how the linear relationship can be restored after the flours are misused. So, the question requires the ability to see the constant ratio based on the linear relationship and to make a calculation for the new situation (Applying appropriate methods or information to new situations).

The Math Questions in 2021 LGS (Translation)	MATH Taxonomy Category	Explanation for Coding
a≠0 and m, n are integers. $\frac{a^m}{a^n} = a^{m-n}$ and $(a^n)^m = a^{n.m}$ Probability of occurrence of an event = the number of favorable outcomes / the total number of possible outcomes The figure below shows a rectangular cardboard with the lengths of 2^5 and 8^4.  This cardboard is cut into equal squares with a length of 2^5 and colored in yellow, red, blue, green, and orange in a pattern. Then, all the square cardboards are put in a bag.  What is the probability that a randomly selected square cardboard is red? A) $\frac{25}{128}$ B) $\frac{1}{5}$ C) $\frac{13}{64}$ D) $\frac{7}{32}$	C1 - Justifying and Interpreting	This question requires the ability first to find the probability value, then make a transition to all possible situations by using the exponential numbers (128 possible situations), and finally to interpret how many pieces will be red in all possible situations by making use of the pattern (Justifying and Interpreting).
a, b are natural numbers. $a\sqrt{b} = \sqrt{a^2 b}$  The figure above shows a circle cardboard with a diameter of KL and a 10 cm ruler. When the point 2 on the ruler is put on the point K, the point L corresponds to somewhere between 6 and 7, more close to 7. So, what is the possible length of the line KL in cm? A) $2\sqrt{5}$ B) $2\sqrt{6}$ C) $3\sqrt{3}$ D) $4\sqrt{3}$	C2 - Implications, Conjectures, and Comparisons	When the operations are performed in the question, it is found that the length of the line segment KL is between 4 and 5. Based on the conjecture that it should be closer to 5, it is decided which length can be a possible option (implication, conjecture, and comparison).
The figure below shows a rectangular running track and the rectangular tribunes K, L, M, and N placed on the long length of this running track. The finish line and one of the sides of the tribune N is linear. The lengths of one side of the tribunes and the distances between the tribunes are given in the figure. The yellow line is parallel to the long side of the running track.  While one of two athletes running on the yellow line towards the finish line passing in front of the tribune K, there is a distance of 46 m between this athlete and the leading athlete. So, which of the following is absolutely wrong about the location of the leading athlete? A) Crossed the finish line B) In front of the tribune M C) Between the tribune L and M D) In front of the tribune L	C3 - Evaluation	The question requires the ability to make a judgment based on the given information (Evaluation).

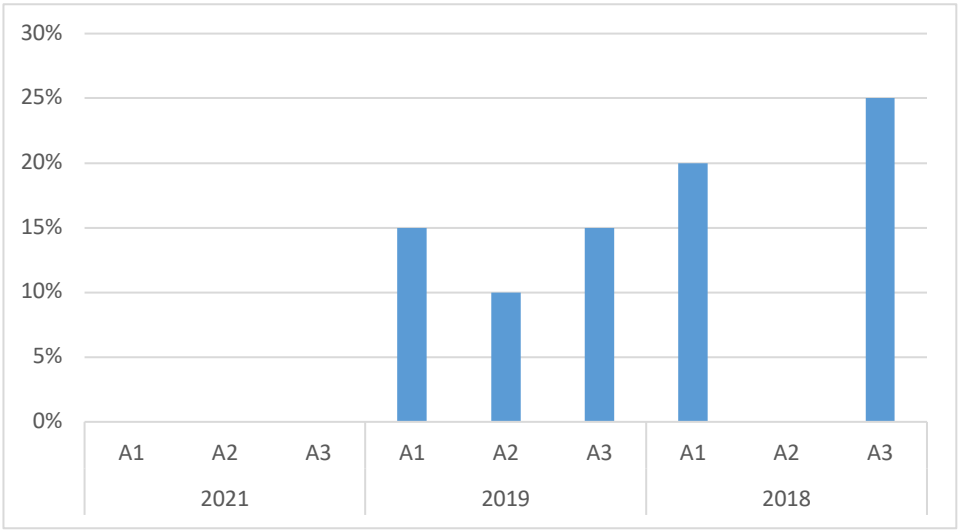
Analysis of the Data Associated with the Fourth Sub-Question

Graph 5 shows the results for the fourth sub-question of the research, that is, "What are the distributions of the math questions in 2018, 2019, and 2021 LGS by the groups and categories in the MATH taxonomy?"



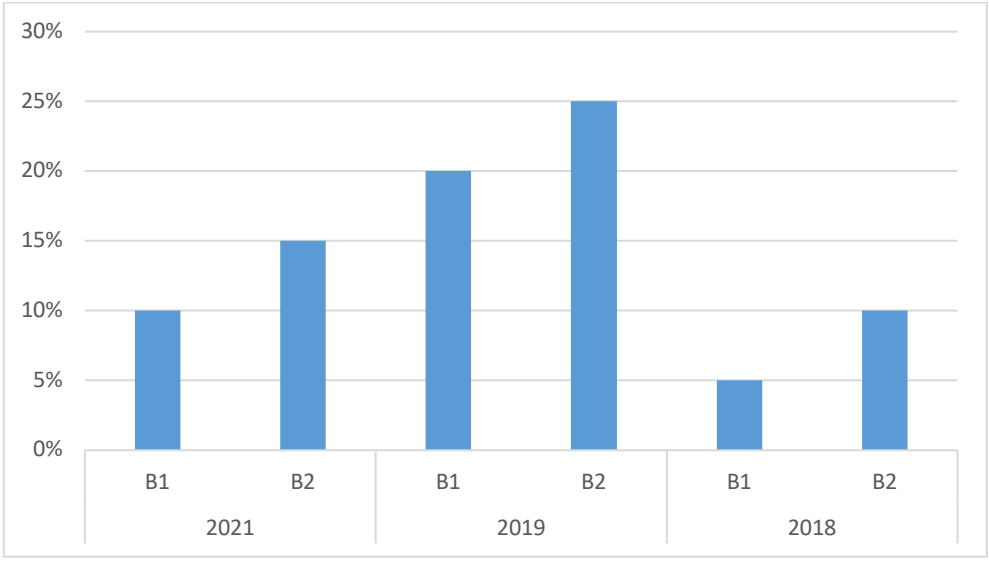
Graph 5. Distributions of the math questions in 2018, 2019, and 2021 LGS by the groups and categories in the MATH taxonomy

Graph 5 shows the distribution of the groups and categories of MATH taxonomy for 2018, 2019, and 2021. The groups A, B, and C were analyzed separately in order to examine how the distribution of the groups of the MATH taxonomy changed over the years. Graph 6 shows the distribution of the questions from the group A by years.



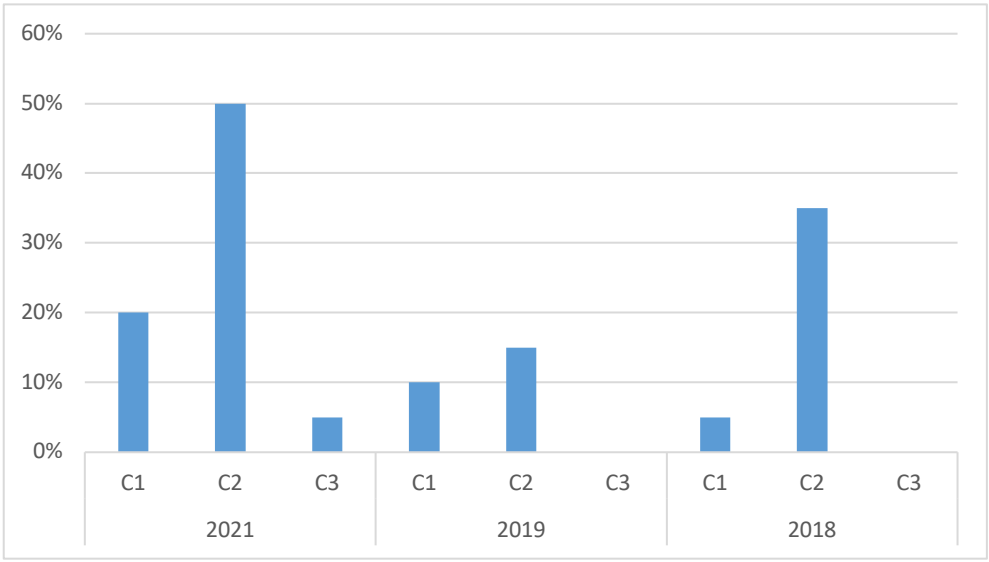
Graph 6. Distributions of the math questions in 2018, 2019, and 2021 LGS by the categories of the group A of the MATH taxonomy

As can be seen in the Graph 6, 45% of the mathematics questions in LGS 2018 and 40% of those in LGS 2019 were from the categories of the group A. In 2021, there were no questions from any category of the group A. When the questions from the group A in 2018 and 2019 were analyzed, it was found that the categories A3 and A1 were dominant. Graph 7 shows the distribution of the questions from the group B by years.



Graph 7. Distributions of the math questions in 2018, 2019, and 2021 LGS by the categories of the group B of the MATH taxonomy

As can be seen in the Graph 7, 15%, 45%, and 25% of the mathematics questions in LGS 2018, 2019, and 2021 were from the categories of the group B, respectively. The percentage of the questions from the category B2 was found to be higher than that of those from the category B1 in all three years. Graph 8 shows the distribution of the questions from the group C by years.



Graph 8. Distributions of the math questions in 2018, 2019, and 2021 LGS by the categories of the group C of the MATH taxonomy

As can be seen in the Graph 8, 40%, 25%, and 75% of the mathematics questions in LGS 2018, 2019, and 2021 were from the categories of the group C, respectively. In 2021, a significant increase was observed in the number of the questions from the category C. Moreover, while there were no questions from the category C3 in 2018 and 2019; for the first time, LGS included a question from the category C3 in 2021. When the percentages of the questions from the categories C1 and C2 were compared, it was found that the percentage of those from the category C2 was higher than that of those from the category C1 in all three years.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

In this study, the math questions in 2021 LGS were examined in terms of their distribution by the groups and categories of the MATH taxonomy and the learning areas, and then the result was compared with those of 2019 and 2018 LGS. First of all, when the mathematics questions in 2021 LGS were analyzed in terms of their distribution by the learning areas, it was found that the questions were mainly from the learning area “geometry and measurement,” followed by “numbers and operations,” “algebra,” “data processing,” and “probability.” It can be asserted that this distribution is generally compatible with the learning outcome related to each learning area in the secondary school mathematics curriculum and the time allocated for teaching that learning outcome. The learning areas “data processing” and “probability” were found to have a minor share in the curriculum in terms of

both the number of learning outcomes and the allocated time. The learning areas “geometry and measurement,” “numbers and operations,” and “algebra” were found to have a similar share in terms of the distribution of the learning outcomes in the curriculum and the allocated time for them.

In this study, if a math question in 2021 LGS involved more than one learning area, these additional areas were considered “linked learning areas.” As a result of the analysis, it was found that most of the questions related to the learning area “geometry and measurement” were also related to “numbers and operations,” and some of them to “algebra.” Similarly, the questions related to “algebra” were found to be also related to “geometry and measurement” and “numbers and operations.” Erdoğan (2020) examined the relationship between mathematical skills and mathematics learning areas and reported that students who correctly answered the questions related to the learning areas "numbers and operations" and "algebra” also had a high ratio of correct answers in the questions related to the learning area "geometry and measurement.” This result supports the existence of a link between the learning areas. The same applies to the learning areas of “data processing” and “probability.”

On the other hand, it was found that the questions directly coded in the learning area “numbers and operations” were not related to other learning areas. For example, a question about exponential numbers directly involves only the learning area of “numbers and operations.” However, the link between “geometry and measurement” and “numbers and operations” is essential. For example, a question related to “geometry and measurement” requires the ability to use the Pythagorean theorem and the knowledge of exponential numbers from the learning area “numbers and operations.” Based on these results, we believe the link between learning areas should be considered in the teaching process. A question can involve more than one learning area; therefore, learning areas should not be considered in isolation.

When the distributions of the mathematics questions in 2021, 2019, and 2018 LGS were compared in learning areas, they were found to have a similar distribution. In all three years, the learning area “geometry and measurement” was found to have the most number of questions, and the learning areas “data processing” and “probability” the least. The learning areas “numbers and operations” and “algebra” were found to have a very close or equal number of questions. It can be asserted that this is generally in harmony with the secondary school mathematics curriculum. These three learning areas have a similar distribution in the curriculum and the LGS questions examined in this study. However, it was found that the percentage of the questions from the learning area "geometry and measurement” was more than its share in the curriculum.

Another point to be noted here is the interrelationship between the learning areas. A question related to “geometry and measurement” also involves other learning areas; therefore, this distribution has no problem. Ekinci and Bal (2019) also reported that the distributions of questions in 2018 and 2019 LGS were similar in learning areas, which was in harmony with the curriculum.

On the other hand, the mathematics questions in 2018 LGS did not involve all learning areas, but those in 2019 and 2021 did. Ekinci and Bal (2019) and Farımaz (2020) also reported the same result for 2019. This result shows that 2019 and 2021 LGS were more aligned with the curriculum than 2018 LGS. Based on the analysis of the questions in 2018 and 2019 LGS, Farımaz (2020) asserted that the number of questions related to the learning areas “data processing” and “probability” should be increased in future exams. However, the number of questions is in harmony with the curriculum; therefore, it can be asserted that there is no need to increase the number of questions. On the other hand, based on the analysis of the questions in 2021 LGS in terms of linked learning areas, it can be asserted that more associations should be built between the learning areas “data processing” and “probability” and the other learning areas. Once this association is built, the learning areas “data processing” and “probability" will be covered by more questions.

When the math questions in 2021 LGS were examined in terms of the groups and categories in the MATH Taxonomy, it was found that there were questions from groups B and C but not from group A. Group C was found to have the most number of questions, with the category C2 (Implications, Conjectures, and Comparisons) having the highest number of questions. Based on these results, the math questions in 2021 LGS were mainly from the higher levels of the MATH taxonomy. When the distributions of the math questions in 2018, 2019, and 2021 LGS were compared in terms of the groups and categories in the MATH taxonomy, it was found that the number of questions from group C increased as the years progressed. Only LGS 2021 included questions from category C3. The previous studies on TEOG (the former equivalent of LGS) reported that the questions from group C needed to be more present in TEOG. The recent increase in the number of questions from group C supports that as the years have progressed, more importance has been attached to measuring the students’ high-level skills. Farımaz (2020) asserted that no questions from category C3 were included in the 2018 and 2019 LGS, and this category was neglected. This need was fulfilled in 2021. Similar to the results of the present study, Gürbüz (2021) also reported a decrease in the number of questions from group A and an increase in those from groups B and C.

The share of the mathematics questions from category C was the highest in 2021 LGS, and there were no questions from category A. This means that students were faced with questions that required them to use their high-order thinking skills. This

result was in line with that reported by Ekinci and Bal (2019). They analyzed the math problems in the 2018 LGS using the revised Bloom's Taxonomy. They reported that the math problems in LGS aimed at measuring students' high-order thinking skills, such as evaluation and interpretation. According to the MATH taxonomy, the math questions in 2021 LGS measure high-order thinking skills, and we believe that such questions will contribute to the development of students' mathematical thinking. Asking questions that do not require students to use their higher-order thinking skills will lead them to think more superficially (Selçuk, 2000).

LGS 2021 included fewer questions from group B than LGS 2019 but more than LGS 2018. The reason for this was the increase in the number of questions from group C. In other words, LGS 2021 included more questions from the top level of the taxonomy than the others. As for the questions from group A, it was found that no questions were included in 2021, and the numbers of questions were similar in 2019 and 2018, but there were fewer questions in 2019 than in 2018. This shows that the number of questions from group A decreased over the years while the number of questions from higher-level groups increased. Compared to years, more importance has been attached to measuring high-level skills.

Students in Turkey take the international exams held by Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA). The structure of TIMSS and PISA exam questions requires students to have high-level skills in problem-solving, such as creative thinking, logic and judgment, reasoning, mathematical communication, correct use of mathematical language, and strategy building (Taş et al., 2016). The TIMSS and PISA results show that Turkey is not sufficiently successful in this regard. There are many reasons for this failure, and one of them is that students do not encounter such questions sufficiently and are not used to them (Aydoğdu İskenderoğlu & Baki, 2011). When the distribution of LGS questions in the MATH taxonomy is analyzed by years, an increase is observed in the number of questions measuring high-level skills (categories B and C). We think that the increase in the number of questions from categories B and C will make the students more used to these types of questions, and this will contribute positively to the success of Turkey in the TIMSS and PISA exams held in the coming years.

One of the particular objectives of the secondary school mathematics curriculum in Turkey is to provide the following skills to students: mathematical literacy, associating mathematical concepts, problem-solving, reasoning, expressing mathematical language correctly and appropriately, using metacognitive knowledge and skills, making generalizations, expressing mathematical concepts using different representations, and communication (MoNE, 2018). Similarly, NCTM (2000) asserts that besides students' success, their skills, such as applying mathematics in daily life, problem-solving, reasoning, self-confidence in mathematics, and communication about mathematics should also be measured. In other words, students must have higher-order thinking skills and apply them to problems. According to the MATH taxonomy, the number of questions measuring higher-order thinking skills in LGS has increased in recent years. This overlaps the objectives of the secondary school mathematics curriculum and NCTM, which is a positive development.

Based on the results of the research, we recommend that:

- the central exams be analyzed according to the MATH taxonomy in order to understand the question structures that can measure more than one knowledge and skill,
- the textbooks be prepared in a way to include the higher-order thinking skills of the MATH taxonomy,
- the teachers be trained on how to prepare questions that involve the higher-order skills of the MATH taxonomy,
- the linked learning areas should be considered in future studies on coding learning areas.

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Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

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| Research Article / Araştırma Makalesi |

Examination of Asik Davut Sulari Turkish Folk Songs in the Context of Values Education

Değerler Eğitimi Bağlamında Aşık Davut Sulari Türkülerinin İncelenmesi

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Keywords

1. Values education
2. Music education
3. Minstrel literature
4. Turkish folk songs
5. Turkish Folk music

Anahtar Kelimeler

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Abstract

This research aims to determine the value themes in the examples of Turkish Folk Music registered in the TRT Turkish Folk Music repertoire and whose source person is Aşık Davut Sulari and to raise awareness in the context of the use of our Turkish Folk Music examples within the scope of values education given in Music, Turkish and Literature courses.

The material group of the study consists of 18 Turkish folk songs registered in the TRT repertoire and whose source person is Aşık Davut Sulari. These folk songs, which constitute the central theme of the study, were determined through a literature review. The study has a qualitative structure, and content analysis method, one of the qualitative research methods, was used to determine the value themes in folk songs. As a result, 19 different value themes were investigated in the folk songs whose content analysis was made.

As a result of the content analysis, the value that was found to be processed the most (in 17 songs) was the "love" value, and the values that were found to be processed the least (1 song each) were "mercy", "compassion", "modesty", "forgiveness" and "austerity". The folk song in which the most value was determined in the lyrics (7 values) was determined as "Vardım Kırklar Kapısına" and the folk songs with the least value (2 values) were determined as "Bir Yiğit Gurbete Düşse", "Durnam Gelir Bizim Elden", "Ey Hamamcı Bu Hamamı", "Şepke'nin Kavakları", "Yaban Gülü müsün Sarp Kayalarda" and "Yaz Ayları Geldi Geçti". Another finding obtained as a result of the content analysis is that the values of "respect," "sobriety" and "generosity" are not used in any folk songs.

Öz

Yapılan bu araştırmanın amacı TRT Türk Halk Müziği repertuvarına kayıtlı ve kaynak kişisi Aşık Davut Sulari olan Türk Halk Müziği örneklerindeki değer temalarını tespit etmek ve Türk Halk Müziği örneklerimizin Müzik, Türkçe ve Edebiyat derslerinde verilen değerler eğitimi kapsamında kullanılması bağlamında farkındalık oluşturmaktır.

Araştırmanın materyal grubunu TRT repertuvarına kayıtlı ve kaynak kişisi Aşık Davut Sulari olan 18 türkü oluşturmaktadır. Çalışmanın ana temasını oluşturan bu türküler literatür taraması yoluyla tespit edilmiştir. Çalışma nitel bir yapıda olup, türkülerdeki değer temalarını tespit etmek için nitel araştırma yöntemlerinden içerik analizi yöntemi kullanılmıştır. İçerik analizi yapılan türkülerde 19 farklı değer teması araştırılmıştır.

Yapılan içerik analizi neticesinde en fazla işlendiği tespit edilen değer (17 türküde) "sevgi" değeri, en az işlendiği tespit edilen değerler ise (1'er türküde) "merhamet", "şefkat", "tevazu", "affedicilik" ve "kanaatkarlık" değerleri olmuştur. Sözlerinde en fazla değerin tespit edildiği türkü (7 değer) "Vardım Kırklar Kapısına" türküsü, en az değerin tespit edildiği türküler ise (2 değer) "Bir Yiğit Gurbete Düşse", "Durnam Gelir Bizim Elden", "Ey Hamamcı Bu Hamamı", "Şepke'nin Kavakları", "Yaban Gülü müsün Sarp Kayalarda" ve "Yaz Ayları Geldi Geçti" olarak tespit edilmiştir. Yapılan içerik analizi sonucu elde edilen bir diğer bulgu ise "saygı", "itidal" ve "cömertlik" değerlerinin hiçbir türküde işlenmediği şeklindedir.

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INTRODUCTION

Factors and forms the basis of identity-personality in adult life. People meet the concept of value at a very early age in the family institution. In the future, it will develop through a social environment, school, Etc. Although value is an abstract concept, it plays a vital role in shaping people's relationships with people, people with society and societies with societies. According to Bacanlı (2011), referring to the etymological structure of the word value, which derives from the verb to touch, means falling to the desired place, reaching, being in return, and coming across. As a concept, value can be defined as the set of rules that enable a society to live in order and togetherness by complying with the regulations of society. Principles such as love, respect, compassion, and friendship, which each individual will learn naturally from their social life without needing academic education, constitute one's first value judgments. From a sociological point of view, the concept of value is accepted as the basic moral principles and beliefs to ensure the continuation of the unity and solidarity of society. Values accepted by the majority of this social group reflect common feelings, goals and interests (Kızılçelik & Erjem, 1992).

Özden (1998) defined the concept of value as “a common thought, purpose, basic moral principles or beliefs that are accepted as true and necessary by the majority of its members in order to ensure and maintain its existence, unity, functioning and continuation of a social group or society.” Kuter and Kuter (2012), on the other hand, defined social values and stated that "helpfulness, solidarity, tolerance, hospitality, patriotism, honesty, goodness, cleanliness, hard work, honesty, love, respect, sensitivity, fairness, sharing which are among the national, spiritual, social, moral and cultural values that form the basic structure of social life.”

Values education, whose main goals are to raise honest people with character, morality, personality and self-control (Yılmaz & Açar, 2021), is thought to have a higher effect as a role model since theoretical transfers are considered to be forgotten in a short time (Bağcı, 2013: 5). In order to raise good individuals, it is necessary to determine the values to be prepared to strengthen some values and contribute to the cognitive and social development of children (Arıcı & Er, 2017). Values education that shapes human life (Yaman, 2014: 18) is crucial in this process.

The subjects included in values education can be listed as relations between individuals, personal roles, beneficial teachings, and international values. The conclusion is that values education is not only formally an education given in schools but also directly affects and concerns one's social life. There are many different teaching and transfer methods of values education. One of them is the values learned from these sources, which are contained in the oral and written cultural elements transmitted from the past to the present, as it can be understood from the explanations of Tümertekin and Özgüç (2002) that “basic information about the lives of societies can be obtained from cultural sources. These resources are material and spiritual. While material cultural elements are the tools and equipment we use in our daily life, clothing and dwellings, intangible cultural elements are folklore, folk songs, stories, beliefs, proverbs, customs and social norms. Intangible cultural elements are generally considered within the context of folk culture. They are passed on from generation to generation, either orally or in writing” our folk music can be accepted as a cultural transmission element and can be used as a values education tool considering the social values it contains. While Sağer and Karagöz (2011) stated that it is crucial to transfer values education through music education, Yılmaz and Açar (2021) drew attention to the importance of this study, Dönmez et al. (2016) expressed their opinion that the art of music is an educational tool that contributes to personal development by stating that “throughout history, the art of music has gained an important place in the daily lives and education systems of nations, both individually and socially. Music was considered art and has also been used as an educational tool to ensure individuals' emotional, mental and personality development”.

The culture of society contains elements that introduce it and narrate its past. Music culture tries to bring them, i.e., all cultural aspects, to future generations by embroidering them. Sometimes unity and solidarity are emphasized; Unity, longing, patriotism, and joy are seen in it. On the other hand, if you do not hear social harmony, social order and human values in your songs, there should be more concerns about the future. Since whatever your songs say, you live it (Akarsu & Yılmaz, 2016).

Turkish Folk Music is an element of folklore that takes its source from the lives of the Anatolian people, in which the social events and subjects such as love, bravery, war, famine, abundance, and migration are handled by the Anatolian people and their main elements are melody and words. TDK (2019) defines values as “the whole of the material and spiritual elements that cover a nation's social, cultural, economic and scientific values .” Yılmaz and Açar (2021) emphasize that these values are seen in the lyrics of folk songs belonging to each region. Containing many values such as love, respect, honesty, justice, tolerance and humility, folk songs convey the values, joys, pains, lifestyles, beliefs, customs and traditions of oral culture from generation to generation. In this respect, it is known that folk songs are effective in helping students gain value judgments due to their content and embodying these values with their melodies (Arıcı & Er, 2017).

The main topic of this research, which is carried out in line with the information given above, is to determine the value themes in Turkish folk songs of which Aşık Davut Sulari is the source person in the dimension of the transfer of social values and discuss and emphasize the importance of the value themes in Turkish folk songs, which are one of our most adopted folklore elements.

The value themes intended to be determined in Turkish folk songs that are the subject of the research are determined in the table below.

Table 1. ***Values Table***

1	Love
2	Respect
3	Justice
4	Integrity-Honesty
5	Patience
6	Mercy
7	Compassion
8	Tolerance
9	Assurance
10	Responsibility
11	Modesty
12	Forgiveness
13	Friendship
14	Courage
15	Gratitude
16	Sobriety
17	Altruism
18	Generosity
19	Austerity

1.1. Aşık Davut Sulari (1925-1984)

Aşık Davut Sulari, whose real name is Davut Ağbaba, was born in the Çayırlı district of Erzincan. Sulari, who went to primary school in Çayırlı, became a minstrel by drinking wine at 17. He took baglama, poetry and folk song lessons from his grandfather, Kaltuk Mehmet Ağa. After getting help from Paşa Doğan, a relative, about the baglama and minstrel tradition, he started to play and sing. Sülari also contributed to the formation of the Konya minstrel festival. For four years, he also worked as a master regional artist in Istanbul and Ankara radios. Sulari, who has an excellent talent for call-and-response duets, folk lyrics, and Türkish folk songs, has an important place in his field, especially among lovers of Alevi origin. The richness of his folk songs has developed thanks to this feature significantly. Sulari, who went to many parts of Turkey and sang folk songs and beauties on his horse, traveled around European countries and impressed many people with his unique folk songs. He has mastered many minstrels such as Daimi (1932-1983), Beyhani (1933-1971) and Kelkitli Serdar. He played and sang with Aşık Reyhani in Turkey and in countries such as Iran, Syria and Iraq. Davut Sulari, who gave concerts in European countries in the 1970s, died in Erzurum during a minstrels' assembly and was buried in Çayırlı, where he was born. (**https://www.turkedebiyati.org/sairler/davut-sulari.html**).

1.2. Purpose of Research and Problem Status

This research aims to determine the values in the values education curriculum in the folk songs included in the TRT repertoire and noted as the source person of Aşık Davut Sulari.

For this purpose, the problem sentence of the research is formed as; What are the Turkish folk songs values that Aşık Davut Sulari made as a source person and included in the TRT repertoire?

2. METHOD

2.1. Research Model

The research is a qualitative study. The lyrics thought to have a value theme in the examined folk songs were determined by making descriptive content analysis, one of the qualitative research methods based on content analysis. Support and opinion were obtained from language experts when analyzing content. The values determined at the end of the study were presented to the views of field experts again. The method of descriptive content analysis means the in-depth examination and editing of qualitative and quantitative studies conducted independently of each other on a particular subject or field. The results obtained in this method are expected to guide future studies on targeted issues (Ültay, E., Akyurt, H., Ültay, N., 2021). Ültay et al. (2021) explained

the general purpose of content analysis as providing a determination that falls within the scope of the subject discussed and that is made to guide the academic studies to be carried out afterward.

2.2. Sample Group

The research sample group consists of 18 Turkish folk songs from the Erzincan region, registered in the TRT repertoire, of which Aşık Davut Sulari is the source. The songs are listed in alphabetical order.

Table 2. Turkish Folk Songs Samples

Number	Song Name	Repertoire No.	Region	Notated by	Complier	Source Person
1	Bana Bu İlim İrfanı Veren	4204	Erzincan/Tercan	Mehmet Erenler	Turan Engin	Aşık Davut Sulari
2	Ben Bir Güzel Sevdim Gönlüm İçinde	4203	Erzincan	Süleyman Yıldız	TRT Music Dept. Turkish Folk Music Directorate	Aşık Davut Sulari
3	Benden Sorulursa Aşık Olanlar	5000	Erzincan/Tercan	Ihsan Ozturk	Aşık Davut Sulari	Aşık Davut Sulari
4	Bir Güzelin Aşığıyım Erenler	3653	Erzincan	Zafer Gündoğdu	From recording	Aşık Davut Sulari
5	Bir Yiğit Gurbete Düşse	2067	Erzincan/Tercan	Yücel Paşmakçı	TRT Istanbul Radio Turkish Folk Music Directorate	Aşık Davut Sulari
6	Çoktan Beri Yollarını Gözlerim	1502	Erzincan/Tercan	Arif Sağ	Ali Ekber Çiçek	Aşık Davut Sulari
7	Durnam Gelir Bizim Elden	4906	Erzincan/Tercan	İhsan Öztürk/Hakan Ünal	TRT Music Dept. Turkish Folk Music Directorate	Aşık Davut Sulari
8	Ela Gözlerini Sevdiğim Dilber	147	Erzincan/Tercan	Muzaffer Sarısözen	Muzaffer Sarısözen	Aşık Davut Sulari
9	Ey Hamamcı Bu Hamamı	1999	Erzincan/Tercan	Nida Tüfekçi	TRT Music Dept. Turkish Folk Music Directorate	Aşık Davut Sulari
10	Gız Senin Derdinden	1039	Erzincan/Tercan	Muzaffer Sarısözen	Muzaffer Sarısözen	Aşık Davut Sulari
11	Kara Kaşlar Siyah Gözler Bedir Üze	659	Erzincan/Tercan	Kubilay Dökmetaş	Kubilay Dökmetaş	Aşık Davut Sulari
12	Seher Vakti Kalkan Kervan	3632	Erzincan/Tercan	Kubilay Dökmetaş-Engin Değirmenci	From recording	Aşık Davut Sulari
13	Siyah Perçemini Dökmüş Yüzüne	2748	Erzincan/Tercan	Erkan Sürmen	TRT Music Dept. Turkish Folk Music Directorate	Aşık Davut Sulari
14	Şepke'nin Kavakları	1198	Erzincan/Tercan	Ahmet Yamacı	Ali Ekber Çiçek	Aşık Davut Sulari
15	Ulu Dağlar Gibi Kar Olan Başım	2745	Erzincan/Tercan	Erkan Sürmen	Ayhan Çabuk	Aşık Davut Sulari
16	Vardım Kırklar Kapısına	3923	Erzincan/Tercan	Yücel Paşmakçı	Turan Engin	Aşık Davut Sulari
17	Yaban Gülü müsün Sarp Kayalarda	4095	Erzincan/Tercan	Ömer Şan	Ömer Şan	Aşık Davut Sulari
18	Yaz Ayları Geldi Geçti	3609	Erzincan/Tercan	Hamdi Özbay	TRT Istanbul Radio Turkish Folk Music Directorate	Aşık Davut Sulari

2.3. Data Collection

The folk songs subject to the research were obtained through a literature review. By scanning the TRT Turkish Folk Music repertoire, firstly, the Turkish folk songs of Aşık Davut Sulari were determined. Then the upper identity analyzes of the identified songs were made and the folk songs whose source person was Aşık Davut Sulari were defined.

2.4. Data Analysis

The content analysis method was used to determine the value themes in the lyrics of the songs subjected to the research. The main purpose of content analysis is to reach concepts and relationships that can explain the collected data. The summarized and interpreted data is subjected to a deep process in content analysis, concepts and themes can be discovered as a result of this analysis. Concepts take the researcher to themes, and thanks to themes, facts can be better edited and made clearer (Yıldırım & Şimşek, 2011). The themes of value sought in the Turkish folk songs that are the research subject were obtained from a book study by Hökelekli (2013).

3. FINDINGS

The values determined in the folk songs, which are the research subject and of which Aşık Davut Sulari is the source person, are given in the table below.

Table 3. ***The Table of Folk Songs whose Source Person is Aşık Davut Sulari and Values in Folk Songs***

Number	Songs	Love	Respect	Justice	Integrity-Honesty	Patience	Mercy	Compassion	Tolerance	Assurance	Responsibility	Modesty	Forgiveness	Friendship	Courage	Gratitude	Sobriety	Altruism	Generousity	Austerity	Total
1	Bana Bu İlim İrfanı Veren	✓	✓		✓	✓															**4**
2	Ben Bir Güzel Sevdim Gönlüm İçinde	✓							✓	✓		✓									**4**
3	Benden Sorulursa Aşık Olanlar	✓	✓			✓						✓									**4**
4	Bir Güzelin Aşığıyım Erenler	✓			✓							✓						✓			**4**
5	Bir Yiğit Gurbete Düşse	✓				✓															**2**
6	Çoktan Beri Yollarını Gözlerim	✓												✓				✓			**3**
7	Durnam Gelir Bizim Elden	✓								✓											**2**
8	Ela Gözlerini Sevdiğim Dilber	✓				✓									✓						**3**
9	Ey Hamamcı Bu Hamamı	✓													✓						**2**
10	Gız Senin Derdinden	✓					✓									✓					**3**
11	Kara Kaşlar Siyah Gözler Bedir Üze	✓			✓						✓										**3**
12	Seher Vakti Kalkan Kervan	✓			✓	✓				✓											**4**
13	Siyah Perçemini Dökmüş Yüzüne	✓				✓				✓											**3**
14	Şepke'nin Kavakları	✓																✓			**2**
15	Ulu Dağlar Gibi Kar Olan Başım	✓			✓	✓	✓	✓												✓	**6**
16	Vardım Kırklar Kapısına	✓	✓		✓					✓	✓		✓			✓					**7**
17	Yaban Gülü müsün Sarp Kayalarda									✓	✓										**2**
18	Yaz Ayları Geldi Geçti	✓									✓										**2**
	Total	**17**	**3**	**0**	**6**	**7**	**2**	**1**	**1**	**6**	**4**	**3**	**1**	**1**	**2**	**2**	**0**	**3**	**0**	**1**	

As seen in Table 3, 18 Turkish folk songs were analyzed. It has been determined that the value of “Love” is used in 17 folk songs, value of “Patience” in 7 folk songs, value of “Integrity and Honesty” in 6 folk songs, value of “Assurance” in 6 songs, value of “Respect” in 3 songs, value of “Mercy” in 2, “Compassion” in 1, and “Tolerance” in 1 song , “Responsibility” value in 4 folk songs, “Modesty” value in 3 folk songs, “Forgiveness” value in 1 folk song, “Friendship” value in 1 folk song, “Courage” value in 2 ballads, “Gratitude” value in 2 folk songs, “Altruism” value in 3 folk songs and the value of “Austerity” in 1 folk song in the examined folk songs. In addition to these findings, there is no song that deals with the values of “Justice”, “Sobriety” and “Generosity”.

When Table 3 is examined, it is seen that the folk song with the most value is “Vardım Kırklar Kapısına” with 10 different value themes. It has been found that 6 values are used in the folk song “Ulu Dağlar Gibi Kar Olan Başım”, 4 values in the folk songs “Bana Bu İlim İrfanı Veren”, “Ben Bir Güzel Sevdim Gönlüm İçinde”, “Benden Sorulursa Aşık Olanlar”, “Bir Güzelin Aşığıyım Erenler and “Seher Vakti Kalkan Kervan”, 3 values in the folk songs named “Çoktan Beri Yollarını Gözlerim”, “Ela Gözlerini Sevdiğim Dilber”, “Gız Senin Derdinden”, “Kara Kaşlar Siyah Gözler Bedir Üze” and “Siyah Perçemini Dökmüş Yüzüne” and 2 values in the folk songs named “Bir Yiğit Gurbete Düşse”, “Durnam Gelir Bizim Elden”, “Ey Hamamcı Bu Hamamı”, “Şepke’nin Kavakları”, “Yaban Gülü müsün Sarp Kayalarda” and “Yaz Ayları Geldi Geçti”.

3.1. Sample Turkish Folk Songs for Value Themes

3.1.1. Love

Seher Vakti Kalkan Kervan

Seher vakti kalkan kervan

İniler de zarılanır

Bir güzele düşen gönül

Çiçeklerden korulanır

In the quatrain above, the value of “love” towards human beings is engraved in the line “bir güzele düşen gönül”. Ashiks express society's common values in their poems by connecting with everyday events. They unite the people on the common points of humanity by talking about universal values such as love, brotherhood and humanity. Their advice is divisive, not judgmental, but rather unifying (Cited by Özdemir, 2016).

3.1.2. Respect

Vardım Kırklar Kapısına

Davut Sular canlar canı

Mevlana Mahmut hayranı

Pirimdir Veysel Karani

In the quatrain above, Davut Sulari stated that he regarded Veysel Karani as a sage and also admired Rumi and Seyit Mahmut, and expressed his respect for them and used the value of “respect”.

3.1.3. Integrity-Honesty

Bir Güzelin Aşığıyım Erenler

Pir Sultan Abdal’ım gamzeler oktur

Hezeran sinemde yaralar çoktur

Benim senden özge sevdiğim yoktur

İnanmazsan ol Allah’a sal beni

Pir Sultan Abdal, addressing the woman he loved in the last two lines of the quatrain, stated that he did not love other than her, that if she did not believe in his love, she could refer himself to God, and that he was so true and honest in his love for her. One of the criteria that determines one’s relationships with other people is integrity. In order to be useful to people and not to mislead them, it is significant for the person to be honest in their deeds and avoid fraudulent ways in the form of a “good person” profile. For this reason, it is seen that the ashiks refer to the concept of integrity to raise qualified people who are suitable for cultural values (Özdemir, 2016).

3.1.4. Patience

Benden Sorulursa Aşık Olanlar

Kişisel olanlar kâinat tanır

Darb-ı Aşk olanlar cihan dolanır

Gahi berrak akar gâhi bulanır

Olgun mertebede kalan aşıktır

In this quatrain, which belongs to Aşık Davut Sulari, it is seen that those who suffer from love and can remain at a mature level without compromising their stance, despite their life going on with uncertainties, express the value of "patience" while expressing that they are true lovers. In one of the studies, Özdemir (2016) explained the theme of patience in a stanza of Aşık Ruhsati by quoting Kaya (1999) as "he says that there are different types of people in society and accordingly different behaviors, so one has to be patient with troubles".

3.1.5. Mercy

Kız Senin Derdinden Derbeder Oldum

Ağır Göl Dağından Gahmut Yaylaya

Hangi gün inersen çektirme gaya

Hayrani der senin gül yüzün maya

Aç gözün aşıkın gör de sonra git

In the second line of this song, of which Davut Sulari is the source person and whose lyrics belong to Aşık Hayrani, the expression "Hangi gün inersen çektirme gaya" expressed his request to the woman he loved not to make him suffer gaya, i.e. trouble, and therefore to show "mercy".

3.1.6. Compassion

Ulu Dağlar Gibi Kar Olan Başım

Ulu dağlar gibi kar olan başım

Gözlerimin yaşı sel değil ya ne

Hep kalkıp iniyor bu zayıf düşüm

Beni taşa tutan el değil ya ne

In the quatrain above, it is understood that the lover is mentally weak due to the love he feels and receives constant criticism from his surroundings for this situation and that he does not receive compassion from either his loved one or his surroundings.

3.1.7. Tolerance

Ben Bir Güzel Sevdim Gönlüm İçinde

Ben bir güzel sevdim gönlüm içinde

Ayağı yok amma gözleri vardır

Dedim güzel nedir sendeki bu hal

Küsmesi yok amma nazları vardır

In this quatrain of the folk song, whose lyrics belong to Davut Sulari, it is seen that in the line "ayağı yok amma gözleri vardır", he mentions that he loves a beautiful woman whose body integrity is not complete and emphasizes the value of "tolerance".

3.1.8. Assurance

Siyah Perçemini Dökmüş Yüzüne

Yandırdın yaktın beni

Zalım aldattın beni

Ne dedim de darıldın

Bir pula sattın beni

In the quatrain above, Davut Sulari stated that he trusted his loved one but that she had cheated on him, and that although he did not make a statement that would upset or offend her, she had betrayed his trust with the phrase "bir pula sattın beni", and he embroidered the theme of "assurance" in these lines.

3.1.9. Responsibility

Yaban Gülü müsün Sarp Kayalarda

Yaban gülü müsün sarp kayalarda

El değmeden solacağın belliydi

Ey vefasız derde saldın başını

Taştan taşa vuracağın belliydi

In the last two lines of the quatrain above, it is seen that the value of "responsibility" is used in these lines, which are expressed as causing trouble due to an unnecessary behavior, attitude, or action and later regretting it.

3.1.10. Modesty

Benden Sorulursa Aşık Olanlar

Ben aşık değilem yoksul ozanım

İçimde dert kaynar bünyem kazanım

Bazı yalçın dağım bazı sazanım

Davut Sularinde kalan aşıktır

In the above quatrain, it is seen that Davut Sulari is emphasizing the value of “modesty” by stating that he is not a master ashik but only a poor bard.

3.1.11. Forgiveness

Vardım Kırklar Kapısına

Evvel Allah ahir Allah

Dönemem Estağfurullah

Bendeyem Allah eyvallah

İmanım Amentübillah

It is seen that the ashik believed in God in the quatrain above, that he could not return from his faith, and that he used the value of “forgiveness” with the word “Estağfurullah”, which also means to ask God for forgiveness.

3.1.12. Friendship

Çoktan Beri Yollarını Gözlerim

Çoktan beri yollarını gözlerim

Gönlümün ziyası dost safa geldin

Şu garip gönlümün bağı bostanı

Ayva ile turunç nar safa geldin

In the first two lines of the above quatrain, it is seen that the ashik uses the value of “friendship”.

3.1.13. Courage

Ey Hamamcı Bu Hamama

Ey hamamcı bu hamama güzellerden kim geldi

İnce belli, dudu dilli, şeker halli yar geldi

Al hançeri, çal sineme, gör sinemde neler var

In the quatrain above, it is seen that the expression “Al hançeri, çal sineme”, which is used to express the feelings in the heart, emphasizes the value of “courage”.

3.1.14. Gratitude

Kız Senin Derdinden Derbeder Oldum

Senin sevdan ile çekerim acı

Hekim der ki sendedir dert ilacı

Bağban bir gül verse benim duacı

Kendi öz bağından der de sonra git

Since praying is an expression of gratitude, it is seen that the ashik has used the value of “gratitude” by stating that he will pray for all those who do good for his own troubles in the phrase “bağban bir gül ver benim duacı” in the quatrain above.

3.1.15. Altruism

Çoktan Beri Yollarını Gözlerim

Yoksa karşımızda oturan mısın

Serimi sevdaya yetiren misin

Ağır yüklerimi götüren misin

Katar maya ile yar safa geldin

Freedman et al. have defined altruism as the behavior of helping others without the expectation of reward in any way, and set its limits by separating altruism from merely helping behavior with the expectation of benefit (Cited by Ersanlı & Çabuker, 2015). Based on this definition, in the lines “serimi sevdaya yetiren misin” and “ağır yüklerimi götüren misin” in the quatrain above, it is seen that the woman he loves has helped him to ease his troubles and emphasizes the value of ”altruism”.

3.1.16. Austerity

Ulu Dağlar Gibi Kar Olan Başım

Fasl-ı muhabbeti bana yetiren

Ulu divan kurup hakka götüren

Cümle müşkül işlerimi bitiren

Edep erkan ile yol değil ya ne

In the first line of the quatrain above, in the expression “bana yetiren”, it is seen that the ashik uses the value of “austerity” by stating that the conversation phase is sufficient for him.

4. CONCLUSION AND RECOMMENDATIONS

According to the results obtained based on the findings of the research, the values of “love, respect, integrity-honesty, patience, mercy, compassion, tolerance, assurance, responsibility, modesty, forgiveness, friendship, courage, gratitude, altruism and austerity” are mentioned in at least one folk song, it has been determined that the values of “justice, sobriety and generosity” are not mentioned in any of the folk songs. It was concluded that the value themes specified in the table were covered 61 times in 18 Turkish folk songs with content analysis. As a result of another research on the subject, it has been determined that the values of justice and restraint, which are not covered in the folk songs whose source person is Aşık Davut Sulari, are used in different folk songs whose lyrics and music belong to him and which are registered in the TRT repertoire. Recommendations that can be submitted in light of these results are;

- Effective use of Turkish Folk Music examples in values education,
- Examining the works of ashiks who have interpreted the feelings and thoughts of the people and bringing them into the literature by revealing the values they cover,
- Giving seminars to today's folk poets within the scope of values education and ensuring that they cover value themes more intensively and consciously in the works they will produce,
- More scientific meetings on the tradition of minstrelsy and values education.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

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| Research Article / Araştırma Makalesi |

From Emergency Remote Teaching to Remote Online Education: Challenges, Benefits and Differences in EFL Setting[1]

Acil Uzaktan Öğretimden Uzaktan Çevrimiçi Eğitime: İngilizce'nin Yabancı Dil Olarak Öğretildiği Ortamda Zorlukları, Faydaları ve Farkları

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Keywords
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2. Covid-19 pandemic
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Abstract

Purpose: Emergency distance learning that started in the middle of 2019-2020 education year caused a lot of uncertainties and even chaos in many education settings around the world. However, conditions were different when the 2020-2021 education year started fully online. This descriptive inquiry aims to explore the views, perceptions, and experiences of learners and instructors, who started fully online distance education in the preparatory class of a School of Foreign Languages at a state university and compare and contrast these experiences with the emergency distance education they had in the previous term.

Design/Methodology/Approach: The participants of the study included 247 students and 27 instructors who were administered open-ended questions as the data collection tool. Hence, the study utilized qualitative data collection and analysis methods.

Findings: The results provided insights about the participants' experiences from various aspects and showed that both parties were conscious of the benefits and challenges of the online courses.

Highlights: Different from emergency remote learning, online classes in 2020-2021 academic year were seemingly organized with better planning, which also contributed to instructors' and students' adaptation.

Öz

Çalışmanın amacı: 2019-2020 eğitim öğretim yılının ortasında başlayan acil uzaktan öğretim, dünyada çoğu eğitim ortamında birçok belirsizliğe ve hatta kaosa sebep olmuştur. Ancak 2020-2021 eğitim öğretim yılı tamamen online eğitime başladığında koşullar farklıydı. Bu betimsel çalışmanın amacı, bir devlet üniversitesinin Yabancı Diller Yüksekokulunda eğitime online başlayan öğrencilerin ve öğretim elemanlarının görüşlerini, algılarını ve deneyimlerini incelemek ve bu deneyimlerini bir önceki dönemdeki acil uzaktan eğitim ile karşılaştırmaktır.

Materyal ve Yöntem: Çalışmanın katılımcılarını 247 öğrenci ve 27 öğretim elemanı oluşturmuştur ve veriler katılımcılara yöneltilen açık uçlu sorular aracılığıyla toplanmıştır. Dolayısıyla alışmada nitel veri toplama ve analiz yöntemleri kullanmıştır.

Bulgular: Çalışmanın bulguları, katılımcıların deneyimlerine çeşitli açılardan ışık tutmuş olup her iki katılımcı grubunun da online derslerin faydalarının ve zorluklarının farkında olduklarını göstermiştir.

Önemli Vurgular: Acil uzaktan eğitimden farklı olarak, 2020-2021 akademik yılında online eğitimin daha iyi bir planlama ile yapıldığı görülmüş ve bu durumun öğrencilerin ve öğretim elemanlarının uyum sağlamalarına katkıda bulunduğu saptanmıştır.

[1] Preliminary findings of the instructors' views were presented at *International Conference: Teaching Foreign Languages during Pandemics*, organized by Bartın University on 19-20 June, 2021

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INTRODUCTION

Throughout the history, technology and foreign language learning and teaching practices have gone hand in hand. Access to authentic materials and the importance of the exposure to the target language through various sources have made the use of technologies an essential part of foreign language education. While technology could be utilized as supplementary to face-to-face instruction through blended learning (Thronbury, 2006), instruction could also be provided fully online in cases when students and teachers are in separate environments (Keegan, 1996).

Distance education can be implemented as synchronous and asynchronous; while the former is associated with the separation of the instructor and learners in terms of place, the latter is associated with the separation of instructors and learners in terms of both time and place; asynchronous instruction enables users to adjust time and pace in line with their own needs (Clark, 2020; Lew & Nordquist, 2016). In addition to these, hybrid methods enable using both forms in tandem; namely, partly synchronous and partly asynchronous forms of delivery can be adjusted according to teaching and learning purposes (Karaaslan, Kilic, Guven-Yalcin & Gullu, 2018). Blended learning also enables to combine traditional classroom training with e-learning activities, and it is considered to help students to access knowledge at their own pace and location (Singh, 2003).

Although the notion of distance education has been in the agenda of researchers for a long time (Keegan, 1990; Sweet, 1989; Willis, 1993), the extraordinary circumstances caused by the pandemic has made it compulsory worldwide, and Turkey is no different. In April 2020, when the World Health Organization announced the case as pandemic, educational institutions encountered a big uncertainty. All on-going activities needed to be turned to a long-term solution without face-to-face interaction. Hence, education practices at various levels were moved to online platforms in most institutions. This temporary shift of alternate delivery mode caused by a crisis is referred as Emergency Remote Teaching (ERT).

Under the extraordinary circumstances the world was in, changing only the learning platform and maintaining learning activities using innovative methods could be considered something positive (Karataş and Tuncer, 2020). Besides, flexibility of the learning practices in terms of time and place is also perceived an advantage (Biasutti, Frate, and Concina, 2019). However, the shift was so sudden and it has brought serious challenges. As stated by Hodges et al. (2020), “the speed with which this move to online instruction is expected to happen is unprecedented and staggering” (p.2).

Previous studies showed that when they were asked whether online teaching or face-to-face teaching was effective, both instructors and students reported to benefit less from online teaching and learning due to factors including but not limited to technical problems, lack of necessary equipment, and lack of concentration (İşpınar-Akçayoğlu & Dişlen-Dağgöl, 2021). This result is somewhat expected because of the careful design process that was absent in the emergency shift. Effective online learning results from careful instructional design and planning as well as the use of a systematic model for design and development (Branch and Dousay, 2015). The hurried move made many instructors and students think that online learning was only a weak option.

There were still some uncertain issues when the new education year began in September, 2020; whether having face-to-face education or hybrid models or going fully online affected all the planning options in the education institutions around the world. Specific to the School of Foreign Languages, clearer rules and a more organized framework needed to be provided, which required taking issues recommended by Means, Bakia, and Murphy (2014) into consideration. In their book entitled Learning Online: What Research Tells Us about Whether, When, and How, Means et al. (2014) mentioned nine dimensions in the design and decision-making processes in online education, which included: 1) modality, 2) pacing, 3) student-instructor ratio, 4) pedagogy, 5) instructor role online, 6) student role online, 7) online communication synchrony, 8) role of online assessments, and 9) source of feedback.

Emergency online learning did not make it possible to take actions in line with these details. Establishing a system that supports distance learning took time to identify and build. Hodes et al. (2020) states that it takes six to nine months to plan, prepare, and develop time for a fully online university course. Lacking this background, the emergency remote teaching process ended with everyone doing the best they can but questioning the effectiveness and resisting its challenges.

The rapid approach to delivering courses online due to the extraordinary conditions should not be mistaken for long-term solutions; it was a temporary solution to an immediate problem (Hodges et al., 2020). Its effectiveness was initially assessed by comparing it face-to-face version. However, such comparison provides no real value because as suggested by Surry and Ensminger (2001), any medium is merely a way to deliver information; different media and the way people learn with different media should be understood well; and there are too many variables associated with the validity of the results of any comparison. The world is still affected by the circumstances caused by the pandemic. However, the new year started with new, more carefully designed decisions. The response of learners and instructors to the changes with the changing variables is a topic worth exploring and is believed to fill a gap in the literature. Therefore, the purpose of this study is to identify the views, perceptions, and experiences of learners and instructors who started educations fully online in the School of Foreign Languages of a state university and compare and contrast these experiences with the emergency distance education they had in the previous term.

METHOD/MATERIALS

Research Design and Participants

This study utilized a phenomenological study design, which is qualitative in nature. Qualitative research is a systematic and subjective approach to explore daily life experiences and give them meaning (Burns and Grove, 2009) and discover the complexities of the situation through a holistic framework (Holloway and Wheeler, 2002). In this study, students' and instructors' experiences in a unique period when all the respondents in this study went through fully online education. Reality is subjective and perceived differently by individuals (Creswell, 2007). Phenomenological study design plays a crucial role in collecting rich and in-depth data to understand the phenomenon under study and enables to examine how people make sense of their life experiences and allows the nuanced explication of participants' experiences (Smith, Flowers, & Larkin, 2009).

This descriptive inquiry utilized a qualitative research design. The study included English language instructors (n=27) and prep school students (n=247) who were enrolled in the preparatory program of a School of Foreign Languages at a state university. Purposive Sampling method was utilized for the selection of the study group. Since the aim of the study was to elicit views of both instructors and students about distance education in language learning and teaching process, only the prep school instructors and students were included in the study.

Data Collection Instruments

The qualitative data were gathered through open-ended questions administrated to both instructors and students. The instructors were asked six open-ended questions, which included 1. What kind of difficulties have you experienced in online classroom teaching this semester? 2. Compared to last semester, what kind of strong points of online classrooms can you identify for this semester? 3. What skills do you think the students developed best during online distance teaching this semester? 4. What skills do you think the students developed least during online distance teaching this semester? 5. Compared to last semester, what differences have you observed in student attitudes and behaviors towards distance learning? 6. What factors had effects on the changes in students' attitudes towards distance education, if any?

The participating students were also asked six open-ended questions, which included 1. Considering your experience of being a prep student this year, what kind of advantages do you think the distance education has 2. Considering your experience of being a prep student this year, what kind of disadvantages do you think the distance education has? 3. How do you solve the problems that you encounter in distance education? 4. If you had any chance to choose, would you prefer traditional classes or online learning classes? Why? 5. Considering your experience of being a prep student this year, in which areas do you think you improved most? 6. What are your suggestions or the things that you would like to state about your experience of distance education this year?

Data Analysis

The gathered data were analyzed qualitatively and subjected to content analysis. The present study applied conventional content analysis in which the coding categories were directly developed from the text data (Hsieh & Shannon, 2005). The themes and their frequencies driven from the data were presented in tables. All answers of the all participants were included into the content analysis process.

FINDINGS

The findings of the study are presented in two parts: findings of the instructors' views and findings of the students' views.

Findings of the Instructors' Views

The instructors were posed six open-ended questions, and findings concerning their responses to those questions are given in tables below. Table 1 is about the instructors' views on the difficulties experienced in online classroom teaching and the strong points of online teaching as compared to emergency distance learning abruptly transferred into at the beginning of COVID-19 pandemic

Table 1. Difficulties and strong points of online classroom teaching

Difficulties Experienced in Online Teaching		**Strong Points of Online Teaching**	
Themes	f	**Themes**	f
Technical problems	8	Using a different, more interactive platform	13
Students' refusing to have camera on during the lesson	7	More interaction	9
Lack of participation	6	Using a different platform for assignments	7
Difficulties in motivating the students	6	Increased readiness for online classrooms	6
Time constraints	5	Higher participation rates	5

Difficulties Experienced in Online Teaching		Strong Points of Online Teaching	
Low attendance levels	5	Higher attendance rates	4
Students' lack of necessary equipment	4	Increased motivation	3
Assessment	4	More structured and clearly set teaching and learning experiences	2
Lack of interaction	3	More smooth implementations	2
Difficulties in monitoring students' learning	2	Better assessment of teaching and learning	2
Workload	2		
Distractors (kids, knocking doors, etc.)	2		

The instructors expressed their views regarding the difficulties experienced by teachers in the online classroom teaching during the first semester of the new education year that started to be implemented fully online. Technical problems (f=8) was the top-indicated factor. Other most frequently mentioned items included students' refusing to have camera on during the lesson (f=7), lack of participation (f=6), time constraints (f=5), low attendance levels (f=5), students' lack of necessary equipment (f=4), difficulties in motivating the students (f=4), difficulties in getting to know students, and assessment (f=4).

The teachers were also asked to compare their teaching experience in the new semester with their emergency teaching experience last semester. As the new year started with new decisions, the instructors' responses to this question reflected the effects of these decisions. The biggest change was found to be the change in the teaching platform. Being more familiar with online teaching in the new semester, instructors observed more interaction (f=9) and higher participation (f=5) and attendance (f=4) rates. From the affective perspective, increased motivation (f=3) and increased readiness (f=3) were among the strong points of online teaching cited by the instructors. From the instructional aspect, instructors reportedly conducted their classes in a more clear and structured way (f=2) and made a better assessment of teaching and learning process (f=2).

As far as the students' skills developed through online learning are concerned, instructors' views ranged from language skills to study skills as shown in Figure 1 below.

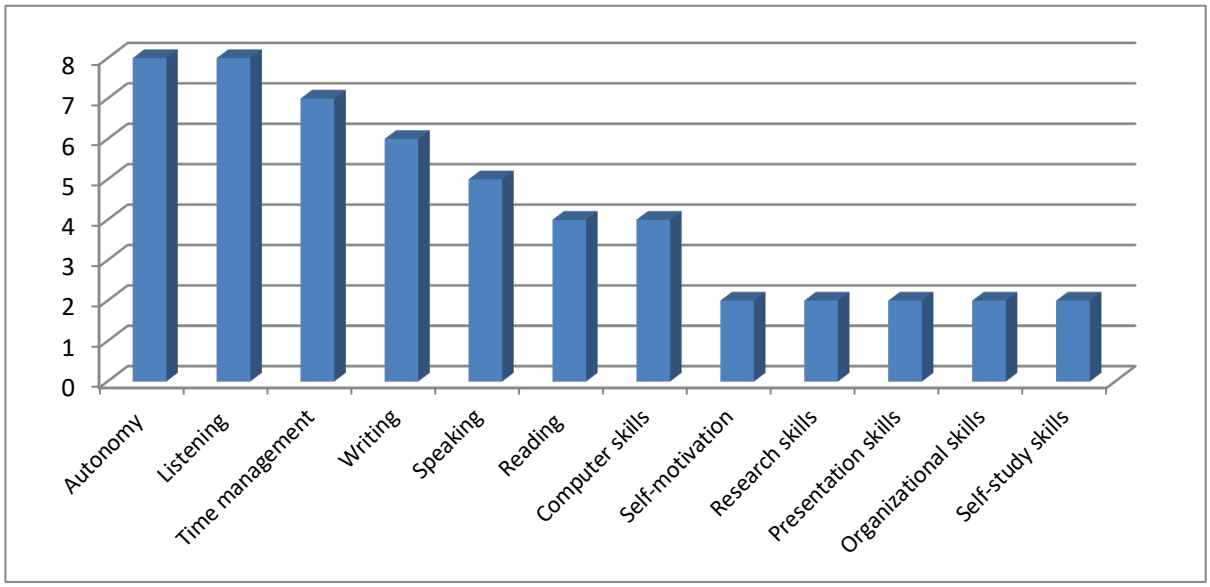

Figure 1. Instructors' Views about skills the students developed best

The instructors were asked what skills they thought their students improved most during the education in the pandemic process. The instructors thought that the students developed mostly autonomy (f=8), listening (f=8), time management (f=7), and writing (f=6) skills. Although the findings showed that the students improved their language skills (writing, speaking, and reading respectively), the answers also indicated improvements beyond language skills. Other responses included computer skills (f=4), research skills (f=2), presentations skills (f=2), organizational skills (f=2), and self-study skills (f=2).

In addition to skills developed best in online education, participating instructors were asked about the skills the students improved least during online distance teaching. Their responses are displayed in Figure 2.

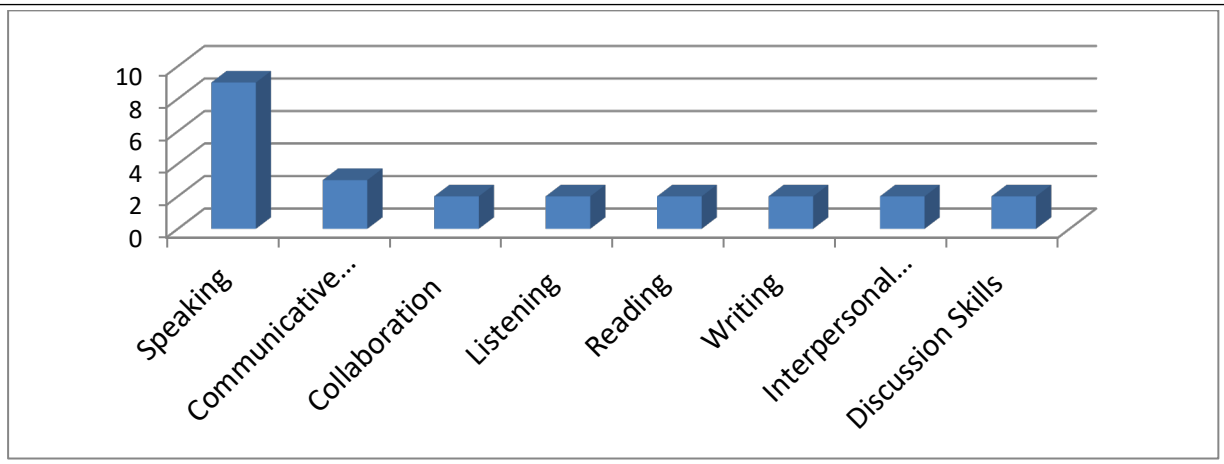

Figure 2. Skills the students developed least during online distance teaching this semester

Apart from the language skills such as speaking (f=9), listening (f=2), reading (f=2) and writing (f=2), the instructors' responses centred on the skills that implied interaction and cooperation such as communicative skills (f=3), collaboration (f=2), interpersonal skills (f=2), and discussion skills (f=2).

The instructors were also asked about probable differences in students' attitudes and behaviours towards distance learning compared to last semester as well as the perceived factors behind these changes. The results are presented in Table 2.

Table 2. Changes in student attitudes and the perceived factors behind these changes

Differences in student attitudes		**Factors on the changes in students' attitudes**	
Themes	f	**Themes**	f
More adaptation	17	Getting used to the new conditions	23
Higher motivation to learn	12	More technical and mental readiness	8
Higher participation rates	10	Teachers' attitudes and behaviors	4
New assessment criteria	4	Assessment criteria and obligatory attendance	4
Less confusion about what to do	4	The new, more interactive platform	4
Students' higher responsibility about their own learning	3	Students' being technically prepared	3
Completion of the assignments regularly	2		
Less plagiarism	2		

Participating instructors in this study had two distance learning experiences. While they began to teach online in the middle of the education year in the first year (2019-2020), they started fully online at the beginning of the following education year (2020-2021). When the instructors were asked about the differences they observed in student attitudes and behaviours towards distance learning between these two experiences, they stated that the students were more adapted (prepared) this year (f=17); they were more motivated to learn (f=12); they had higher participation rates (f=10); new assessment criteria helped students to form better attitudes (f=4); they seemed to take more responsibility of their own learning (f=3), and they seemed to fight with the reality of distance education less (f=2). Some teachers also mentioned factors such as less confusion (f=2), doing assignments more regularly (f=2), less plagiarism (f=2), and the role of the new platform (f=2). The instructors remarked their opinions about the possible factors that influenced changes in students' stance towards distance learning.

Getting acquainted with online learning was the most frequently cited factor that caused shifts in students' attitudes (f=23). In addition, the instructors' being technically and mentally ready and more organized (f=8), their attitudes (f=4), increased experience in distance education (f=4), making attendance obligatory (f=4) and more interactive platform (f=3) were listed as other factors leading changes in students' attitudes.

Findings of the Students' Views

The students were also posed six open-ended questions. Table 3 presents participating students' views on the advantages and the disadvantages of distance education in language learning.

Table 3. Advantages and Disadvantages of Distance Education in Language Learning

Advantages		**Disadvantages**	
Themes	f	**Themes**	f
No advantages	65	Technical problems	64
More chances to study individually	40	Not finding courses beneficial	56
Studying more comfortably at home	39	Lack of speaking practice	47
More time-saving	23	Lack of communication/socialising	34
Instant access to resources online	16	Lack of interaction	23
Having less expenses	10	Concentration problem	17
More healthy these days	9	Lack of classroom atmosphere	15
Less anxiety	9	Fewer class hours	12
Easier attendance to the classes	8	Distance education itself	9
Easy access to the course recordings	8	Physical and psychological distance from school	9
Teacher support	8	Limited activities	9
Efficiency	7	Lack of participation	5
Better use of technology	5	Physical problems such as headache and tiredness	6
Online assignments	4	Abundance of assignments	5
No problem of transportation/ accommodation	4	Lack of motivation	5
No problem of being late	3	Lack of self-confidence	4
More self-regulation	3	Improving slowly	4
Increased concentration on class	2	Lack of attendance	3
		Adaptation problem	3
		Distractors	3
		Feeling uneasy in front of camera	3
		Feeling as if listening to radio	2
		Disregarding the course	2
		Lack of university's readiness	1

When the students were asked about the advantages of the distance education in language learning, a great majority was found to think that distance education had no advantages (f=65). Those who found it advantageous stated its benefits from different perspectives that were not limited to language learning. The students cited more chances to study individually during online learning process most frequently (f=40), which was followed by studying more comfortably at home (f=39). Having more time (f=23), accessing online resources during the course instantly (f=16), having less expenses at home (f=10), staying healthy at home (f=9), being less anxious (f=9), attending classes easily (f=8), and being able to listen to the course recordings later (f=8) were the frequently cited advantages of online learning. The students also remarked that distance education allowed them to use technology better (f=5) and regulate their own learning process (f=3). Their responses concerning the disadvantages are displayed in the following table.

When the students were asked about the disadvantages of distance education in language learning, although some students remarked no disadvantages (f=13), most of the students gave various responses regarding the issue. For example, majority of the students complained about the technical problems (f=64) and many students did not find online classes beneficial (f=56). Concerning the language skills, the students believed that online learning led to lack of speaking practice (f=47), causing difficulties in listening-speaking skills and pronunciation. Another significant problem was cited as lack of communication/socializing (f=34) and lack of interaction (f=23). Difficulties in concentration (f=17), lack of classroom atmosphere (f=15), fewer class hours (f=12) and limited activities in class (f=9), physical and psychological distance from school (f=9), physical problems (f=6), lack of motivation (f=5) and self-confidence (f=4), slow improvement (f=4) and distractors (f=3) were the other disadvantages indicated by the students. Although cited once, lack of institution's readiness for distance education stood out as a noteworthy drawback. In addition to the problems, students also stated their own solutions they found against the problems experienced in online learning.

Table 4. Students' solutions to the problems experienced in distance education

Themes	f
Consulting the teacher	57
Consulting peers	49
Benefitting from internet	18
Using different tools such as phone, notebook	17
Consulting others who have more knowledge	12
Consulting family members	5
Using extra sources	5
Studying/ doing in-class activities at home/ Making preparations beforehand	5
Buying the required tools	3
Watching the recordings	2
Getting tuition	2
Organizing the learning environment	2

Some students were found to have no problems in distance education (f=18) while some of them experienced nothing except for technical problems (f=22). In face of the problems students experienced in online learning, they seemed to prefer consulting the teacher (f=57) and peers (f=49). Seeking such help from people was followed by seeking help from the internet (f=18). In case of technical problems, they appeared to incline to use different tools such cell phones or notebook (f=12). When it comes to study skills, the students were found to use extra sources (f=5) and make more effort (f=5), including application of in-class activities at home and making preparations beforehand. Watching the course recordings (f=2) and environment structuring (f=2) were also cited among students' problem-solving skills.

Table 5. What would you prefer if you had any chance to choose?

Traditional class (173)	Online learning class (57)	Hybrid (3)
More beneficial (57)	Health reasons (15)	For applied activities (1)
More communication (23)	More comfortable (5)	Appropriate for the conditions of the era (1)
More speaking practice (17)	More time to study (4)	Better for working students (1)
Classroom atmosphere (11)	Lack of waste of time (4)	
No technical problems (8)	Beneficial (5)	
More fun and candid (7)	More practical (4)	
More concentration (6)	Less anxiety (3)	
More active learning (5)	No transportation problem (2)	
More motivation (3)	Free of possible problems at school	
More disciplined (3)	atmosphere (2)	
Too much homework in online (2)	Easy Access to classes (2)	
Less problematic (2)	Fast Access to information (2)	
Psychologically and physically better (2)	Learning-centred (1)	
Easy and fast problem solving (1)	Better use of technology (1)	
More attendance (1)	Environment structuring (1)	
More self-confidence (1)	Being more active in class (1)	
Peer support (1)	One-to-one communication (1)	
Less inequality of opportunity (1)	Better for working students (1)	

The findings of the students' preference for traditional or online classes showed that more than half of the students had tendency towards traditional classroom (f=173). Participating students found traditional classroom more beneficial (f=57) and believed that it promoted more communication (f=23) and more speaking practice (f=17). Additionally, the students were found to experience the classroom atmosphere more in traditional learning environment (f=11). Traditional classroom was also regarded to boost fun (f=7), concentration (f=6), active learning (f=5) and motivation (f=3). Lack of technical problems (f=8) was also a factor that attracted students to the traditional classrooms more. Those who preferred online learning (f=57) cited health reasons most frequently (f=15). Comfortable (f=5), time-saving (f=8), practical (f=4) and secure (f=2) side of online learning was also specified by the students. Easy access to classes (f=2) and information online (f=2) were among the tendencies for distance education. Few students proposed the application of hybrid learning environment, mix of both traditional and online classes.

Participating students were asked what improvements they perceived in their learning. The results are shown in Figure 3.

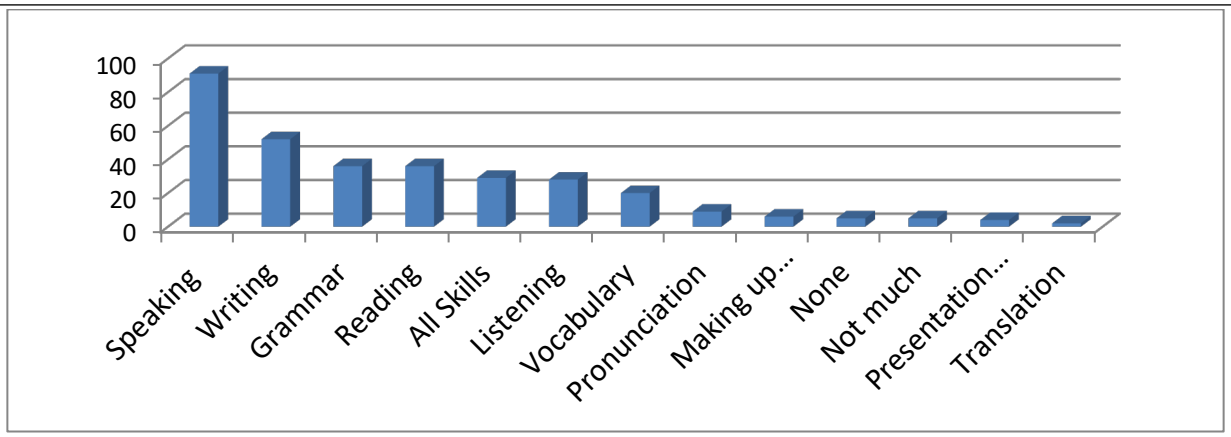

Figure 3. Improvements in English as Perceived by Students

Most students thought that they improved their speaking skills (f=91), and almost half of the students thought that they improved their writing skills (f=52). A group of students noticed improvements in their grammar and reading skills (f=36 each), and another group of students (f=29) believed that they improved in all skills. Despite their perceived improvement in English through online learning, the students had some suggestions for more improvements in distance education.

Table 6. Students' suggestions for improvement

Themes	f
Going back to face-to-face education	55
No suggestions	34
Less assignments	18
Going on online education	16
More speaking practice out of lessons	14
More interactions with teachers and administrators	11
Increased lesson hours	7
Lower passing grade	6
More activities to increase motivation	5
Hybrid education	5
Less equipment and connection problems	5

When the students were asked whether they had any suggestions for improvement, while 34 students had no suggestions (f=34), around half (f=55) stated that they wanted to have face-to-face education, but several students stated that they wanted to go on online education (f=16). While some students thought that too much homework is assigned (f=18), another group stated that SFL provided good learning opportunities (f=15). However, the need for more interaction with teachers and administrators were also indicated as they wanted to have more speaking practice out of lessons (f=14) and interact with teachers and students more

DISCUSSION

Covid-19 Pandemic caused a lot of educational institutions including universities to move into online learning abruptly in 2019-2020 academic year spring semester; however, the rapid spread of the pandemic prevented universities from conducting the classes face-to-face in the 2020-2021 academic year as well. Therefore, both students and instructors were more aware of the synchronous online learning this year in comparison to the emergency distance education where they found themselves without any preparation in the previous year. Considering this issue, the present study explored the views and experiences of the students and instructors on synchronous online education within the frame of foreign language learning and teaching. Twenty-seven English language instructors and 247 prep-school students participated in the study and remarked their perceptions of online language education in various respects.

The instructors' views focused on difficulties experienced in online language teaching, strong points of online teaching compared to emergency distance education, the skills students improved best and least, probable differences in students' attitudes towards online learning compared to last semester, and the perceived factors causing those differences. According to the participant instructors, the greatest difficulties in online teaching were technical problems and students' refusal to keep their cameras on during the lesson. Other studies in the literature (Gok, 2015; Koç, 2020; Perveen, 2016) also identified technical problems as one of the challenges of distance learning. Therefore, while preparing a lesson plan for online classes, a room could be spared for such possible technical issues which cannot be controlled by instructors or students. Regarding the camera issue, Gherheş, Şimon and Para (2021) highlighted the instructors' complaint about students' discomfort with keeping their cameras on, and found the anxiety, shyness, privacy issues and physical location as the main reasons. In this regard, instructors could address students' concerns more and understand their refusal while at the same time encouraging their interaction more by offering

alternatives. This learner-centered approach could also be useful for lacks of motivation and interaction that the instructors viewed as other challenges of synchronous online learning because in another study (Ke & Kwak, 2013), as critical constructs of learner centeredness, active learning and learner autonomy predicted students' perceived satisfaction with online courses at a statistically significant level. Assessment presented itself as a factor causing difficulty as well.

Use of more interactive platforms such as Google Meet and Google Classroom was regarded as the strong points of this year in online education. Higher interaction, participation and attendance compared to last year were also reported to be positive sides. One of the significant positive changes was found to be increased readiness for online learning this year. Educators should pay attention to such kind of a change because, as Engin (2017) claims, readiness leads to changes in learners' behavior and it is important for a student to have online readiness to be able to benefit from online learning settings. Thus, readiness is a key factor (Cabi & Kalelioğlu, 2019) and it could even increase students' satisfaction of online learning (Topal, 2016). Since the second year in distance education during Covid-19 pandemic was more planned by the institutions, students could get adapted to the e-learning process better, and this finding turned out to be a positive change.

As for the skills the students developed best through the eyes of instructors, extra lingual skills presented themselves as autonomy and time management. As a matter of fact, autonomy occupies a more significant place in distance education (Fotiadou, Angelaki & Mavroidis, 2017) and the nature of online learning setting requires autonomy (Cullen &Harris, 2018). Similar to the present study, Baru, Tenggara and Mataram (2020) found greater autonomy through the use of online learning media in EFL setting. Language skills, on the other hand, included listening and writing. However, possibly due to the nature of the online learning, skills such as speaking, communication and collaboration were reported to be developed least.

When compared to emergency remote learning last year, the instructors observed some changes in students' attitudes towards distance education this semester such as increased adaptation and experience with online learning and higher motivation. This also contributed to an increase in participation and a decrease in confusion. Another significant positive change in students was higher responsibility they took for their own learning. According to instructors, increased familiarity with online learning, and mental and technical readiness for the process were the possible factors that led to these changes.

When it comes to students' views, they centered on the advantages and disadvantages of online learning, possible solutions for the challenges, preferences between traditional or online classroom, their perceived improvement in English through distance education, and suggestions for possible steps to take to make online learning more efficient. Within the frame of advantages, a great majority of the students found no positive sides in online learning. In another study conducted with 762 participants, disadvantages outnumbered the advantages, as well (Coman, Țîru, Meseșan-Schmitz, Stanciu & Bularca, 2020). However, more chances to study individually and comfortably at home, time management, instant access to online resources and less financial problems were the most frequently cited advantages of online learning. Easier attendance to the classes and access to the course recordings were also noted as positive sides. As a matter of fact, flexibility proved to be one of the key benefits of online learning (Buselic, 2016; de Oliveira, Penedo & Pereira, 2018; Young, 2006). Despite low frequency, better use of technology and more self-regulation were among the significant points of online learning. As for the disadvantages, technical problems were found to be the greatest drawback of the distance education as indicated in the instructors' responses. Likewise, a number of students did not find the courses beneficial as suggested by other studies (Elshami, Taha, MAbuzaid, Saravanan, Al Kawas & Abdalla, 2021; Ullah, Asraf, Asraf & Ahmed, 2021). From a communicative aspect, students were not pleased with the lacks of speaking practice, communication/socializing and interaction. Similarly, EFL learners were found to have lower motivation levels owing to lack of social interaction in online learning (Meşe & Sevilen, 2021). Physical and psychological distance was also a problem for the students. The study conducted by Park and Bonk (2007) also identified the students' need for the sense of community and social presence in online learning. According to Trespalacios and Uribe-Florez (2020), multimodal and scaffolding activities could be a tool for sense of community, which could even impact success and retention of students in distance education. Inclusion of social media tools such as Facebook, twitting and blogging (Young & Bruce, 2011) and games, online discussions and peer teaching (Shackelford & Maxwell, 2012) into the curriculum could further enhance social presence and sense of community. Although activities planned for lessons mainly focus on academic success of students, social needs of students should not be disregarded in online learning setting. Thus, an online class based on Vygotsky's (1978) social constructivism, which highlights active involvement and interaction, could help educators to build an isolation-free learning atmosphere. Similarly, difficulties in concentration, lack of classroom atmosphere, fewer class hours and limited activities were cited as negative sides of online learning. Though not cited frequently, distractors were also among the class-related problems. In affective respect, lacks of motivation and self-confidence and sense of uneasiness in front of camera caused students to feel negative about online learning, which was also remarked by the instructors.

Despite the challenges of online learning, students seemed to cope with the problems they experienced, and the most frequently used solution was found to be consulting the instructors and the peers. The students seemingly benefitted from internet and extra sources.

Given all the benefits and drawbacks of distance learning, a great majority of students reportedly preferred traditional classrooms since they found it more effective. Likewise, another inquiry by Alawamleh, Al-Twait and Al-Saht (2020) indicated that students preferred face-to-face classrooms due to lacks of motivation and comprehension, decrease in communication and sense of isolation in online setting during COVID-19 pandemic. However, the present study also revealed that health conditions were the greatest reason for those who were in favor of online learning. Although online learning could help students to save their

health, they do not find it as efficient as conventional classes (Yuzulia, 2021). Minority of the students recommended the use of hybrid learning for applied activities and for the students who needed to both work and attend school.

As to the linguistic improvements, students observed a progress in all language skills; nonetheless, they perceived an improvement in productive skills as speaking and writing. Although instructors observed students' speaking as the least developed skill, students viewed their speaking improved in online learning. This implies that criteria for progress in both parties' minds are not same, and the students' self-evaluation and the teachers' evaluation of the students may yield different results and thus lead to different expectations. Moreover, students may not be aware of self-assessment strategies because the findings of the study by Thawabieh (2017) emphasized that students, if not provided with feedback on self-assessment, could tend to evaluate their performance higher than their teacher.

Considering various aspects of online education, students suggested going back to face-to-face classrooms to make the learning process more fruitful. However, it should be noted that when implemented well with experience and appropriate study skills, distance learning could be quite useful for students, instructors, and institutions.

CONCLUSION AND RECOMMENDATIONS

Considering the students' and instructors' views and experiences, the present study attempted to get insight into the online learning in English courses at the tertiary level in the second year of the COVID-19 pandemic. Both parties were conscious of the benefits and challenges of the online courses. Different from emergency remote learning, online classes in the 2020-2021 academic year were seemingly organized with better planning, which also contributed to instructors' and students' adaptation. Given the perceptions of the instructors and students regarding the online learning experience, the study has some recommendations. Firstly, the readiness issue should not be neglected by the educators and policy makers since it could profoundly affect the learning process itself. It may represent the key step in rendering the process more meaningful and purposeful. Second, challenges should be identified clearly and possible precautions should be taken considering the context and circumstances. Meanwhile, the instructors should address the students' concerns, and the institutions could organize an orientation program or training for instructors and students to lessen the uncertainties. Different online programs or tools could be offered to make learning more active and interactive. Last but not least, viewing this extraordinary condition as an opportunity, instructors should encourage students to gain autonomy and lifelong learning skills.

LIMITATIONS

The present study included only qualitative data collected from a single institution; therefore, it could be supported by a quantitative data collection tool. Additionally, the number of the participant instructors could be increased to elicit a more general picture of their views

Declaration of Conflicting Interests

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

Ethics Committee Approval for this research was obtained from the Research and Publication Committee on Ethics at Adana Alparslan Türkeş Science and Technology University (Reference number: E-76907350-050.01.04-2050; Date: 27/01/2021)

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| Research Article / Araştırma Makalesi |

Pre-Service Pre-School Teachers' Music Education Self-Efficacy Levels: A Case Study

Okul Öncesi Öğretmen Adaylarının Müzik Eğitimi Öz-Yeterlik İnanç Düzeyleri: Durum Çalışması

Esra Yücesan[1]

Keywords

1. Self-efficacy belief
2. Music education self-efficacy belief
3. Music education in early childhood
4. Teacher training
5. Professional development in music education

Anahtar Kelimeler

1. Öz-Yeterlik İnancı
2. Müzik Eğitimi Öz Yeterlik İnancı
3. Okul Öncesi Dönem Müzik Eğitimi
4. Öğretmen Yetiştirme
5. Müzik eğitiminde profesyonel gelişim

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Abstract

Purpose: This study aims to examine pre-service preschool teachers' music education self-efficacy levels in terms of their gender and grades.

Design: The research has been designed as descriptive research based on the survey model. The data collection tool includes the 'Music Education Self-Efficacy Scale for Preschool Teacher Candidates' developed by Yıldız (2017). The study group includes 221 pre-service preschool teachers.

Findings: Research indicates that pre-service preschool teachers' music education self-efficacy is at a 'good level.' Considering grades, it is found that as the grade level increases, there is an increase in the self-efficacy beliefs of pre-service preschool teachers related to music education. The lowest music education self-efficacy levels belong to freshman pre-service preschool teachers, and the highest music education self-efficacy levels belong to senior pre-service preschool teachers. However, it is found that the music education self-efficacy levels do not significantly differ according to gender.

Highlights: It draws attention to a significant increase in the music education self-efficacy belief levels of the 3rd and 4th grade pre-service preschool teachers who took 'Early Childhood Music Education' as a compulsory course in the 2nd year of undergraduate education.

Öz

Bu araştırmada okul öncesi öğretmen adaylarının müzik eğitimine yönelik öz yeterlik inanç düzeylerinin sınıf ve cinsiyet değişkenleri açısından incelenmesi amaçlanmıştır.

Araştırma tarama modeli temel alınarak hazırlanmış betimsel bir araştırma olarak desenlenmiştir. Araştırmanın çalışma grubunu 221 okul öncesi öğretmen adayı oluşturmuştur. Veri toplama aracı olarak Yıldız (2017) tarafından geliştirilen 'Okul Öncesi Öğretmen Adaylarının Müzik Eğitimi Öz-Yeterlik İnancı Ölçeği' kullanılmıştır.

Araştırma bulguları okul öncesi öğretmen adaylarının müzik eğitimi öz yeterlik inanç düzeylerinin 'iyi düzeyde' olduğunu ortaya koymuştur. Sınıf değişkenine göre; sınıf düzeyi yükseldikçe müzik eğitimine ilişkin öz-yeterlik inanç düzeylerinin de yükseldiği, en düşük müzik eğitimi öz-yeterlik inanç düzeyi puanlarının birinci sınıfta öğrenim görmekte olan okul öncesi öğretmen adaylarına, en yüksek müzik eğitimi öz-yeterlik inanç düzeyi puanlarının ise dördüncü sınıfta öğrenim görmekte olan okul öncesi öğretmen adaylarına ait olduğu tespit edilmiştir. Bununla birlikte müzik eğitimi öz yeterlik inanç düzeylerinin cinsiyet değişkenine göre anlamlı bir farklılık göstermediği tespit edilmiştir.

Önemli vurgular: Lisans eğitiminin ikinci senesinde zorunlu ders olarak 'Erken Çocuklukta Müzik Eğitimi' alan 3. ve 4. sınıf okul öncesi öğretmen adaylarının müzik eğitimi öz yeterlik inanç düzeylerinde ortaya çıkan anlamlı artış dikkat çekmektedir.

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INTRODUCTION

Self-efficacy is one of the basic concepts that Albert Bandura -the developer of social cognitive theory- thought practical on behavior. While Bandura (1986) defines self-efficacy as "the individual's judgment about his/her capacity to organize and successfully perform the necessary activities to show a certain performance" (as cited in Senemoğlu, 2005, p. 216,230), Senemoğlu makes a definition of self-efficacy as "to what degree an individual can overcome difficult situations that s/he may face in the future." She describes it as "one's judgment and belief about himself/herself that s/he can be successful." According to Senemoğlu, self-efficacy is not a function of an individual's skills but a product and result of his/her judgments about what s/he can do with his/her skills (Senemoğlu, 2005, p. 230,231). According to Bandura (1980), four essential sources affect individuals' self-efficacy judgments. These resources include (1) the information that the individual has obtained as a result of successful or unsuccessful activities that he has done directly, (2) the successful or unsuccessful activities of other people who are similar to himself/herself, and the 'indirect experiences' of the individual, which can be explained as the judgment of whether s/he can achieve the same activities himself. (3) 'Verbal persuasion,' which can be explained as advice, advice, and incentives that an individual has received regarding whether he or she can succeed or fail to succeed. (4) Psychological state. Individuals with a high perceived self-efficacy level are less afraid of trying anything and are more insistent on trying more to overcome any task (Cited by Senemoğlu, 2005, 231).

Self-efficacy motivates teachers for their work and supports them in developing self-confidence in their professional lives. A high self-efficacy belief is also fundamental for teachers to create an effective learning environment (Öztutgan, 2018, p. 576). Teachers' self-efficacy beliefs towards fulfilling their duties are related to their classroom management skills, the methods they prefer and students' effort levels to be successful (Kurt, 2012, p. 202). Teacher self-efficacy belief can be defined as teachers' inner beliefs about how well they can do the activities, and they can produce solutions for possible problems they may encounter in their education processes (Kaçar & Beycioğlu, 2017, p. 1755). According to Duy (2014), teachers with a high perception of self-efficacy work hard even if there are students who resist learning. Teachers with high self-efficacy are committed to teaching. Teachers with high self-efficacy perceptions have confidence in themselves and their students (cited by Kaçar & Beycioğlu, 2017, p. 1755).

All development areas' skills and personality roots are laid in the preschool period (Uçal, 2003, p. 14). Therefore the child needs a suitable environment and preschool education in which qualified cognitive stimuli, rich language interactions, and positive social and emotional experiences are offered (Ministry of National Education of Turkey [MEB], 2013, p. 12). One of the fields that has an important place in this multidimensional preschool education process is children's musical education. The child's musical development is a product of the interaction of heredity and environment (Yıldız, 2002, p. 3). Since this educational process will directly affect the child's knowledge and skills about music, it is an issue that should be carefully considered (Göncü, 2010, p. 356). Such a musical education is only possible with well-trained and equipped preschool teachers (Yıldız, 2017, p. 398). Preschool teachers need high levels of competence and self-efficacy in music education to apply music activities as progressive and intertwined with different disciplines and also by the characteristics of early childhood.

Bartel and Cameron (2002) refer to self-efficacy in music education, stressing that self-efficacy is socially constructed and that music practices and teaching processes are social. They emphasize that individuals' self-efficacy perceptions in these processes are partially formed through their interactions with other individuals and music (p. 1). According to Russell-Bowie (2010), pre-service preschool teachers' musical backgrounds and experiences improve their musical perceptions and enable them to reach a certain level of self-efficacy in music teaching. Many teachers who do not have a musical background feel inadequate for musical experiences (as cited in Burak, 2019, p. 259). In the study of Akpınar (2021) with preschool teachers, it was found that the music education self-efficacy belief levels of the teachers who took place in seminars or training on music education were higher than those of the preschool teachers who have not (p. 87). The findings of the research conducted by Vannatta-Hall (2010) with preschool teachers also support this finding. The research results reveal a holistic increase in the self-efficacy levels of pre-service preschool teachers who took lessons on music teaching methods for fifteen weeks (p. 151). Considering the literature, the relationship between preschool teachers' music-related experiences and their music education self-efficacy belief levels makes it essential for preschool teachers to take music education as an undergraduate course. Within the scope of 'Early Childhood Music Education and 'Early Childhood Rhythm, Dance and Orff Education courses, which have music and music education-related course contents determined by the Council of Higher Education in Turkey [YÖK] (2018) within preschool education undergraduate program, the following contents are included:

"The importance of music in preschool education, the relationship between music and education,

"Planning, implementing and evaluating musical activities following the preschool education program."

"Playing-singing-listening with the Orff Approach." All course topics are available in the same program (p. 8,22).

When the competency/skill expressions that constitute the music education self-efficacy beliefs of preschool teachers are examined, it is observed that these skills are closely related to the achievements of music education courses they have taken during their undergraduate education. Some of these music education self-efficacy competency expressions are given below:

…I can plan a musical activity suitable for the child's musical development characteristics,

…I know the musical development characteristics of children… (Yıldız, 2017, p. 406,407),

…I know Orff instruments, I have knowledge about how to use them, and I can use this information in my professional life… (Öztutgan, 2018, 581).

The successful implementation of qualified music education programs in early childhood mostly depends on teachers' beliefs in music teaching self-efficacy, in other words, their beliefs in their ability to teach music and produce positive results (Vannatta-Hall, 2010, p. 4,5). According to Afacan (2008), there is a relationship between teachers' self-efficacy in teaching music and student success. Afacan (2008) stresses that when teachers are aware of their competencies, are self-confident and believe they can succeed, this situation increases their desire to learn and try and apply methods that will make their students more successful. Afacan emphasizes that there is a relationship between teachers' success and their self-efficacy -who can endear music and themselves and teach knowledge by experiencing it through music, like playing a game (p. 2). Research findings in the study of Akpınar (2021) with preschool teachers also support the views of Afacan (2008). Research findings reveal that the self-efficacy belief levels of preschool teachers who use contemporary teaching methods and approaches while performing music activities are higher than those who do not utilize these methods and approaches (p. 88).

When the literature in Turkey is reviewed, several studies examining the music education self-efficacy belief levels of preschool teachers and pre-service teachers and obtaining different results for different dimensions (Salı, Akkol, & Oğuz, 2013; Koca, 2016; Ersoydan, Şahin, & Çalışandemir, 2018; Öztutgan, 2018). When the international literature is examined, it is observed that the studies on the music education self-efficacy beliefs have been mainly carried out with the classroom teachers working at the elementary education level and the pre-service teachers in the field (Bartel & Cameron, 2002; Buckner, 2008; Garvis, 2013); on the other hand, there are carried out few studies carried out with pre-service and in-service preschool teachers (Rajan, 2017; Sušić, 2018).

Özkut and Kaya (2012) examine the effects of the music education that preschool teachers have taken during their undergraduate program on their professional life; they emphasize the importance of music education courses in preschool education departments and also stress that the content knowledge and experience acquired by pre-service preschool teachers in education faculties significantly affects their success in their professional life (p. 170). For this reason, pre-service preschool teachers need to have self-efficacy beliefs towards music education, which can be considered as one of the predictors of being practical and thriving in the process of music education they will carry out throughout their professional life. The research aims to identify music education self-efficacy levels and examine gender and grade variables. Additionally, since there are very few studies examining the perceived self-confidence and competencies of pre-service preschool teachers in music education in the international literature (Vannatta-Hall, 2010, p. 150,151), it is aimed with this research to contribute to the national and international literature.

Research problems in this study include:

1. What is the general level of pre-service preschool teachers' music education self-efficacy?

1.1. Do pre-service preschool teachers' music education self-efficacy levels differ according to gender?

1.2. Do pre-service preschool teachers' music education self-efficacy levels differ according to their grades?

METHOD/MATERIALS

Research Model

This research is survey research which is descriptive by nature to identify participants' music education self-efficacy levels. According to Karasar (2005), survey research is a type of research approach that aims to describe a past or present situation as it is. The event that is the subject of the research is not attempted to be changed or affected in any way. It is only attempted to be defined in its context (p. 77). For this purpose, within the scope of the research, it is aimed to identify music education self-efficacy levels of first, 2nd, 3rd and 4th-year undergraduate pre-service teachers studying in the department of preschool education and to examine their self-efficacy levels in terms of gender and grade variables.

Study Group

The study group of the research is selected by the homogeneous sampling method, one of the purposive sampling methods. As a type of purposive sampling method, the purpose of homogeneous sampling is to "identify a distinct subgroup by creating a small homogeneous sample" (Patton, 1987 as cited in Yıldırım & Şimşek, 2016, p. 118,120). For this purpose, the research includes 1st, 2nd, and 3rd 4th-year undergraduate pre-service teachers studying in the department of preschool education at a state university in the 2021-2022 academic year. Table 1 presents descriptive statistics for the study group:

Table 1. Descriptives of participants by gender and grade level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	173	76,5	76,5	76,5
	Male	53	23,5	23,5	100,0
	Total	226	100,0	100,0	

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Freshman	55	24,3	24,3	24,3
	Sophomore	48	21,2	21,2	45,6
	Junior	54	23,9	23,9	69,5
	Senior	69	30,5	30,5	100,0
	Total	226	100,0	100,0	

When Table 1 is reviewed, it is seen that 226 pre-service pre-school teachers at total [173 females and 53 males] are included in the study. Of the pre-service teachers participating in the study, it is seen that 24.3 percent (n=55) include freshmen, 21.2 percent (n=48) include sophomores, 23.9 percent (n=54) include juniors, and 30.5 percent (n=69) include seniors.

Data Collection Tool

In this study, the "Music Education Self-Efficacy Scale for Preschool Teacher Candidates" developed by Yıldız (2017) has been used to identify the music education self-efficacy levels of pre-service pre-school teachers. The Cronbach Alpha reliability coefficient of the scale has been found as 0.94, and this scale has one factor (p. 403,404). Table 2 presents the Cronbach Alpha internal reliability coefficient regarding the reliability of the measurement tool in this study:

Table 2. The result of the Cronbach's Alpha coefficient for the Measurements

N	**the Cronbach's Alpha coefficient of the original scale**	**the Cronbach's Alpha coefficient in this scale**
33	0.964	0.915

When Table 2 is examined, the value obtained in the original study regarding the internal consistency coefficient is found as (α)= 0.964. In this study, the internal consistency coefficient of the scale is found to be (α)= 0.915. Considering that the internal consistency coefficient required to indicate that a scale is reliable is at least 0.70 (as cited in Nunnally, Liu, 2003, p. 211), it is observed that there is a high reliability of the measurements in this study.

Data Analysis

This section gives information about the method to analyze the quantitative data collected to examine the music education self-efficacy levels of pre-service preschool teachers. In order to determine the tests to be used in the data analysis, it is first examined whether the parametric assumptions are met. In order to use parametric tests, the data must be normally distributed. The Kolmogorov-Smirnov test, one of the normality tests, is used to determine the conformity of the data to the normal distribution, and the Q-Q Plot is also examined. Kolmogorov-Smirnov test results are given in Table 3:

Table 3. Kolmogorov-Smirnov Test related to normality of the research data

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistics	df	p	Statistics	df	p
Music Education Self-Efficacy	,052	226	,200*	,989	226	,076

When Table 3 is examined, it comes out that the data in this study met the assumption of normality distribution as a result of the Kolmogorov-Smirnov test (p>05). The result of the Q-Q plot graph regarding the data of the study is given in Figure 1:

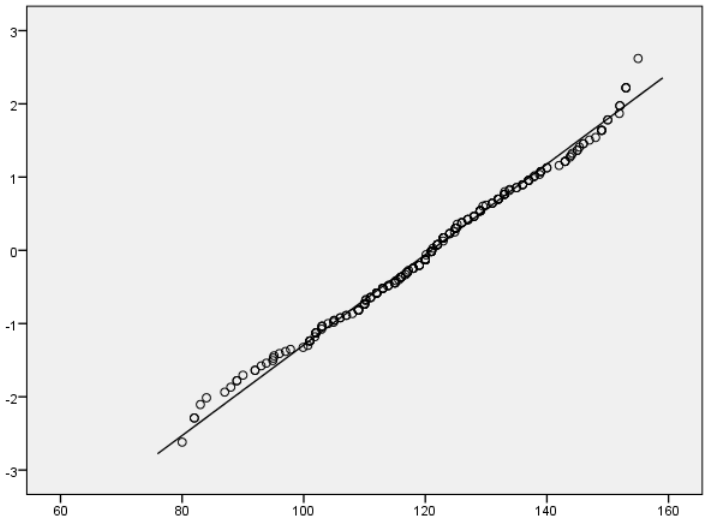

Figure 1: Q-Q Plot Graph about whether the data of the study are normally distributed

When Figure 1 is examined, it is observed that there are no extreme values that disrupt normality in the data of the research, and that the data meets the assumption of normality distribution. As the parametric assumptions are met, parametric tests have been preferred namely t-test for independent samples and One-way ANOVA tests.

FINDINGS

In this section, research problems are attempted to be answered by applying statistical tests. First, descriptive statistics such as mean, median and standard deviation are presented to identify the music education self-efficacy levels of pre-service preschool teachers. Then, the results of the parametric tests are given.

Table 4. Descriptive statistics related to pre-service pre-school teachers' music education self-efficacy levels

			Statistic	Std. Error
Music Education Self-Efficacy	$\bar{x}$		120,9311	1,07662
	95% Confidence Interval	Lower Bound	118,8096	
		Upper Bound	123,0527	
	5% Trimmed Mean		121,1614	
	Median		121,0000	
	Variance		261,960	
	Std. Deviation		16,18517	
	Minimum		80,00	
	Maximum		155,00	
	Range		75,00	
	Interquartile Range		21,78	
	Skewness		-,143	,162
	Kurtosis		-,227	,322

When Table 4 is examined, it is revealed that the mean of total scores of pre-service preschool teachers' music education self-efficacy is $\bar{x}$= 120.93. In other words, it is observed that pre-service preschool teachers have a good level of music education self-efficacy. The lowest self-efficacy score taken from the scale is 80.00; the highest self-efficacy score is 155.00. Independent Samples t-test is conducted to identify whether the pre-service preschool teachers' music education self-efficacy levels differ in gender variable. Table 5 presents independent samples t-test results related to gender variables:

Table 5. Mean scores of pre-service pre-school teachers' music education self-efficacy according to gender variable

	Gender	N	x̄	Std. Deviation	Std. Error
Music Education Self-Efficacy Total Scores	Female	173	121,9336	16,05035	1,22029
	Male	53	117,6590	16,34372	2,24498

When Table 5 is examined, it is revealed that the mean score of female pre-service preschool teachers' music education self-efficacy is x̄= 121.93. In contrast, the mean score of male pre-service preschool teachers' music education self-efficacy is x̄= 117.65. When the mean scores are examined, it is observed that female pre-service preschool teachers' music education self-efficacy levels are higher. Table 6 presents the independent samples t-test result regarding whether this difference is significant in terms of gender variable:

Table 6. Independent samples t-test result of pre-service pre-school teachers' music education self-efficacy levels according to gender variable

		Levene test for equality of variances		t-test						
		F	p	t	df	p	Mean Difference	Std. Error Difference	95% Confidence Interval	
									Lowest	Highest
Music Education Self-Efficacy	Equal variances assumed	,003	,954	1,689	224	,093	4,27463	2,53063	-,71226	9,26153

When Table 6 is examined, it is found out that the music education self-efficacy levels of female pre-service pre-school teachers (x̄= 121.93) do not significantly differ compared to male pre-service pre-school teachers (x̄=117.65) [t(224) = 1.68, p >.05].

Table 7 presents the mean of total score of pre-service pre-school teachers' music education self-efficacy depending on their grade levels:

Table 7. The mean of total score of pre-service pre-school teachers' music education self-efficacy beliefs depending on their grade levels

Grade	x̄	Standard Error
Freshmen	113,31	1,8966
Sophomores	115,30	2,2139
Juniors	124,00	2,0288
Seniors	128,51	1,8602

When Table 7 is examined, it has been identified that the lowest music education self-efficacy scores belong to the pre-service preschool teachers studying in the first grade (freshman), and the highest music education self-efficacy scores belong to the pre-service preschool teachers studying in the fourth grade (senior). It is observed that as the grade level increases, the music education self-efficacy belief levels also increase. A one-Way ANOVA test has been performed to determine whether these differences between grades are statistically significant. Table 8 presents the One-Way ANOVA test result:

Table 8. One-Way ANOVA test result related to pre-service pre-school teachers' music education self-efficacy levels depending on grade variable

Music Education Self-Efficacy Levels Depending on Grade Variable

	Sum of Squares	df	Mean Square	F	p
Within group	9180,848	3	3060,283	13,653	,000
Between groups	49760,120	222	224,145		
Total	58940,968	225			

When Table 8 is examined, the result of One-Way ANOVA test indicates that music education self-efficacy levels of the pre-service pre-school teachers differ significantly according to the grade level [F(3,222) = 13.65, p<.05]. Table 9 presents the result of Bonferroni test -one of the post hoc tests- which has been performed to determine between which groups there exists a significant difference:

Table 9. Bonferroni Post Hoc test result for multiple comparisons

Bonferroni						
(I) Grade	(J) Grade	Mean Difference (I-J)	Std. Error	p	95% Confidence Interval	
					The lowest	The highest
Freshman	Sophomore	-1,98481	2,95720	1,000	-9,8572	5,8876
	Junior	-10,68448*	2,86813	,001	-18,3198	-3,0492
	Senior	-15,19182*	2,70626	,000	-22,3962	-7,9875
Sophomore	Freshman	1,98481	2,95720	1,000	-5,8876	9,8572
	Sophomore	-8,69967*	2,96993	,023	-16,6060	-,7934
	Senior	-13,20701*	2,81392	,000	-20,6980	-5,7160
Junior	Freshman	10,68448*	2,86813	,001	3,0492	18,3198
	Sophomore	8,69967*	2,96993	,023	,7934	16,6060
	Senior	-4,50734	2,72017	,594	-11,7487	2,7340
Senior	Freshman	15,19182*	2,70626	,000	7,9875	22,3962
	Sophomore	13,20701*	2,81392	,000	5,7160	20,6980
	Junior	4,50734	2,72017	,594	-2,7340	11,7487

* p= .05

When Table 9 is examined, as a result of the Bonferroni test, it is revealed that music education self-efficacy levels of the pre-service pre-school teachers studying in the fourth grade are higher than the pre-service pre-school teachers studying in the first-grade [difference of the mean=15.19, p<0.05]. Secondly, it is found that music education self-efficacy levels of the fourth-grade pre-service teachers are higher than the music education self-efficacy levels of the second-grade pre-service teachers [difference of the mean=13.20, p<0.05]. Thirdly, it is found that music education self-efficacy levels of the preschool teachers studying in the third grade are higher than the music education self-efficacy levels of the pre-service pre-school teachers studying in the first-grade [difference of the mean=10.68, p<0.05]. Finally, it is found that music education self-efficacy levels of the pre-service preschool teachers studying in the third grade are higher than music education self-efficacy levels of the pre-service preschool teachers studying in the second grade [difference of the mean=8.69, p<0.05].

DISCUSSION

Within the scope of the research, it comes out that the mean of total scores of the pre-service preschool teachers' music education self-efficacy is found as x̄=120.93. This mean score is interpreted as good when evaluated from the highest total score obtained from the scale (x̄=165). When the literature is examined, there are studies supporting this finding and others that do not compromise with this finding. In the study conducted by Ersoydan, Şahin, and Çalışandemir (2018) with 354 pre-service preschool teachers studying in the 3rd and 4th grades of three different public universities in the 2017-2018 academic year, the music education self-efficacy of the pre-service preschool teachers is examined. It is found that their music education self-efficacy levels are above the average value. When examined in detail, research findings indicate that pre-service preschool teachers feel more ready and more competent in transforming the theoretical knowledge of music into a life skill, being willing to use knowledge and skills in music, and having self-confidence in the music education processes.

In contrast, they feel less ready for their ability to practice music education, and they feel less competent (p. 61,63,66). Similarly, in the study conducted by Öztutgan (2018) with 253 pre-service preschool teachers, self-efficacy levels of pre-service preschool teachers regarding music education are examined, and it is interpreted that their self-efficacy levels are high in general. It is observed that pre-service preschool teachers had the highest level of music education self-efficacy in motivating students toward the field of music. In contrast, they had the lowest music self-efficacy level regarding time management in music activities (p. 574, 583). The study conducted by Koca (2013) with 120 pre-service preschool teachers studying at a public university found that the pre-service preschool teachers' music education self-efficacy levels are low (p. 897,898).

When the music education self-efficacy levels of the pre-service preschool teachers are analyzed by gender, there is no significant difference between the scores. The research finding is similar to the findings of the studies carried out by Öztutgan

(2018), Koca (2013), Burak (2019) and Ersoydan, Şahin, and Çalışandemir (2018). In the study conducted by Öztutgan (2018) with pre-service preschool teachers, when the self-efficacy levels of pre-service preschool teachers are examined according to gender, it is revealed that there is no significant difference between the scores according to gender (p. 584). Similarly, in the study conducted by Ersoydan, Şahin, and Çalışandemir (2018) with 354 pre-service preschool teachers, the music education self-efficacy levels of the pre-service teachers are examined in terms of various variables. The research findings indicate no significant difference between the pre-service preschool teachers' music education self-efficacy perceptions depending on their gender (p. 60,61,67). The sample of research in which the music education self-efficacy levels of pre-service preschool teachers are examined by Koca (2013) consists of 120 pre-service preschool teachers. When the music education self-efficacy levels of the pre-service teachers are examined, it is identified that there is no significant difference between the scores depending on gender (p. 897,898,899). In addition, the research conducted by Burak (2019) has similar findings. The study conducted with 395 pre-service classroom and preschool teachers aimed to examine the effects of factors such as gender, age, years of education, and musical experience on their musical skills and music education self-efficacy. The research findings reveal that there is no significant difference between the scores when the music education self-efficacy levels of the pre-service teachers are examined by gender (p. 257,265).

When the music education self-efficacy levels of the pre-service teachers are analyzed depending on their grades, it is found that the higher the grade level of the pre-service preschool teachers, the higher their self-efficacy levels regarding music education. It has been identified that the lowest music education self-efficacy scores belong to the pre-service preschool teachers studying in the first grade (freshman), and the highest music education self-efficacy scores belong to the pre-service preschool teachers studying in the fourth grade (senior). This conclusion may have been found out because the music-related courses in the curriculum may have had an impact on the music background they had in the 1st grade and they had in the 4th grade. The results of this study show similarities with the research findings of Burak (2019) in some dimensions. In the study by Burak (2019), when the music education self-efficacy scores of the pre-service teachers are examined according to the grade level, it is revealed that there is a significant difference between the scores depending on their grades. The research findings indicate that music education self-efficacy levels vary significantly according to the years of education at the university. It has been identified that as the grade level increases, the music education self-efficacy levels also increase (p. 257,262,266).

Similarly, in the study conducted by Yegül (2014) with pre-service music, classroom, preschool and music teachers, when the music education self-efficacy perceptions of pre-service teachers are examined in terms of grade variable -although it is not statistically significant- it comes out that as the grade level increases, the self-efficacy level in teaching music also increases (p. 587). In the study conducted by Çelenk and Şen (2019) with 361 pre-service teachers studying in the preschool and classroom education departments, the music education self-efficacy perceptions of the pre-service teachers (according to the mean scores of the self-efficacy items) do not significantly vary depending on grade variable (p. 139,146). When the music teaching self-efficacy levels of pre-service preschool teachers are examined in terms of the grade variable, it is observed that different results are obtained in studies conducted with different study groups.

Considering the relationship between the musical experiences of pre-service preschool teachers and their music education self-efficacy levels, it is assumed that the deficiencies in the process of music education of the pre-service preschool teachers are part of the factors affecting the pre-service teachers' self-efficacy levels toward music education. This may create some reasons for the differences in research findings conducted with different study groups. In the study of Vannatta-Hall (2010), there is an increase in self-efficacy levels of pre-service preschool teachers who took lessons on music teaching methods. Vannatta-Hall emphasizes pre-service preschool teachers' experiences in practices such as singing, listening, moving, and integrating music with other disciplines and stresses the importance of being involved in activities and that these practices should be the primary focus of the preschool music education curriculum (p. 151,156). In this context, one dimension of the differences in music education self-efficacy levels may be related to how the pre-service teachers teach the music education courses during their undergraduate curriculum and the physical opportunities-conditions they have. Adequacy of requirements such as having a music classroom, instruments and course materials suitable for activities specific to preschool music education (playing an instrument, listening to music, performing individual and collective playing and singing activities, performing creative movement and dance practices, drama activities, Etc.), It is one of the impressive factors in reaching the achievements for music education in preschool teacher training. In addition to the deficiencies of these opportunities and conditions, there may be deficiencies in the target skills to be acquired in music education. In addition, although preschool music education is included in the literature as a field of expertise, there still needs to be a field-specific undergraduate education program (preschool music teaching) in Turkey. For this reason, instructors who are not experts in the field of preschool music education may be teaching undergraduate-level courses for preschool music education. For this reason, some of the deficiencies appear in reaching course gains.

CONCLUSION AND RECOMMENDATIONS

To conclude, pre-service preschool teachers' music education self-efficacy levels are reasonable. There is no statistically significant difference between their music education self-efficacy levels regarding gender. However, there is a statistically significant difference in music education self-efficacy regarding grades. As the grade level increases, the level of self-efficacy

regarding music education does, too. It comes out that the lowest music education self-efficacy level belongs to the pre-service preschool teachers studying in the first grade, and the highest music education self-efficacy level belongs to the pre-service preschool teachers studying in the fourth grade. This study reveals a significant increase in the self-efficacy beliefs of 3rd and 4th-grade pre-service teachers compared to 1st and 2nd-grade pre-service teachers. Pre-service preschool teachers must complete the 'Early Childhood Music Education' course in the spring semester of the 2nd year of undergraduate education. As a result of this research and the findings of the central studies in the literature draw attention to a significant increase in the music education self-efficacy belief levels of the 3rd and 4th-grade pre-service preschool teachers who took 'Early Childhood Music Education.' Additionally, When the literature is examined, it is observed that there are studies supporting the findings of this research and studies with different results.

Considering the results of this research, the following suggestions can be made within the scope of this study;

- A meta-analysis study can be carried out by collecting quantitative studies with different results.
- It can be suggested to examine the music education self-efficacy levels of pre-service preschool teachers by conducting comprehensive comparison surveys with preschool teachers studying at different universities (state and private universities).
- It would be helpful to conduct research with more participants and universities to see the situation in Turkey.
- Pre-service preschool teachers' music education self-efficacy levels can be examined using qualitative or mixed research methods.
- In Turkey, the Council of Higher Education renewed the preschool teaching undergraduate program in 2018. Experimental studies should be conducted to examine the effects of the new program and the music course and music education course (their content and course hours were also updated) on the music education self-efficacy levels of pre-service preschool teachers.

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Statements of publication ethics

I/We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Ethics Committee Approval Information

As of 2020, researchers applying are required to upload the Ethics Committee Approval Document. Such information as institution name, date, number, etc. regarding the "Ethics Committee Approval Document" should be presented here.

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| Research Article / Araştırma Makalesi |

The Process of Abstraction of Contextual Limit Knowledge

Bağlam Temelli Limit Bilgisinin Soyutlanma Süreci

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Keywords

1. Abstraction
2. Construction
3. Contextual learning
4. Limit concept
5. RBC+C model

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Abstract

Purpose: This study aims to reveal the abstraction processes developed in the minds of pre-service mathematics teachers in problems in which the Limit is designed contextually. The abstractions developed by the pre-service teachers in this process will contribute to teaching the concept of Limit. In this respect, it was aimed to reveal which epistemic actions of the RBC+C abstraction model exhibited in the process of abstracting the concept of Limit while solving the contextually arranged Limit problems.

Design/Methodology/Approach: The case study was used in this study. The research participants are 52 (30 female and 22 male) primary school mathematics teacher candidates. Interviews were conducted with three participants selected by the purposive sampling method. In these interviews, five questions were asked by the researchers to reveal the mathematical thinking levels and abstraction processes of the participants. Semi-structured interviews and observation methods were used to collect data. The data were videotaped and transcribed. Transcripts were analyzed and interpreted according to the cognitive actions of the RBC+C model.

Findings: It was determined that the pre-service teachers who were interviewed developed an understanding of limits and did not experience any difficulties in using this concept in mathematical operations. However, they needed help in transferring the limit information presented in context to new situations, explaining and proving them mathematically. In addition, it was determined that they had difficulty adapting the formal definition to the new situation when faced with the contextual situation in which they could make the formal definition of the Limit. However, it has been observed that a specific conceptual schema is formed in their minds. This shows that they cannot entirely create limit information in their minds. Pre-service teachers structure the formal definition by rote. It was observed that the participants in the excellent category performed the epistemic action of Construction compared to the others.

Highlights: Contextually designed Limit problems show that pre-service teachers have memorized the formal definition of Limit in their minds. They needed help transferring the concept of Limit to different situations and finding solutions to limit problems in contextual situations using the formal definition of the Limit concept. The RBC+C abstraction model is an effective tool in the analysis of contextually designed problem-solving processes.

Öz

Çalışmanın amacı: Bu çalışmada, limitin bağlamsal olarak tasarlandığı problemlerde matematik öğretmen adaylarının zihinlerinde geliştirdikleri soyutlama süreçlerinin ortaya çıkarılması amaçlanmıştır. Öğretmen adaylarının bu süreçte geliştirdikleri soyutlamaların limit kavramının öğretimine katkı sağlayacağı düşünülmektedir. Bu bakımdan öğretmen adayları bağlamsal olarak düzenlenmiş Limit problemlerini çözümlerken limit kavramını soyutlama sürecinde RBC+C soyutlama modelinin hangi epistemik eylemlerini sergiledikleri ortaya çıkarılmak istenmiştir.

Materyal ve Yöntem: Bu çalışmada nitel araştırma türlerinden biri olan durum çalışması kullanılmıştır. Bu araştırmanın katılımcılarını 52 (30 kadın ve 22 erkek) ilkokul matematik öğretmen adayı oluşturmaktadır. Amaçlı örnekleme yöntemi ile seçilen üç katılımcı ile görüşmeler yapılmıştır. Bu görüşmelerde araştırmacılar tarafından katılımcıların matematiksel düşünme düzeylerini ve soyutlama süreçlerini ortaya çıkarmak için beş soru sorulmuştur. Veri toplamak için yarı yapılandırılmış görüşme ve gözlem yöntemleri kullanılmıştır. Veriler videoya kaydedilmiş ve yazıya dökülmüştür. Transkriptler, RBC+C modelinin bilişsel eylemlerine göre analiz edilmiş ve yorumlanmıştır.

Bulgular: Görüşme yapılan öğretmen adaylarının limit anlayışı geliştirdikleri ve bu kavramı matematiksel işlemlerde kullanmakta herhangi bir zorluk yaşamadıkları belirlenmiştir. Ancak bağlam içinde sunulan limit bilgilerini yeni durumlara aktarmada, matematiksel olarak açıklamakta ve ispatlamakta zorlanmışlardır. Ayrıca limitin biçimsel tanımını yapabilecekleri bağlamsal durumla karşılaştıklarında biçimsel tanımı yeni duruma uyarlamakta zorlandıkları belirlenmiştir. Ancak zihinlerinde belirli bir kavramsal şemanın oluştuğu gözlemlenmiştir. Bu da limit bilgilerini zihinlerinde tam olarak oluşturamadıklarını göstermektedir. Öğretmen adaylarının formal tanımı ezber olarak yapılandırdıkları söylenebilir. Öğretmen adayları bağlamsal olarak tasarlanan limit problemlerinin çözümünde limitin tanımı ile ilgili farklı temsiller gösterebilseler de tanımdaki değişkenler hakkında yorum yapamamakta ve özgün bir matematiksel yapı oluşturamamaktadırlar.

Önemli Vurgular: Bağlamsal olarak tasarlanan Limit problemleri göstermektedir ki öğretmen adayları Limitin formal tanımını zihinlerinde ezber olarak yapılandırmışlardır. Farklı durumlara Limit kavramını transfer etmede ve Limit kavramının formal tanımını kullanarak bağlamsal durumlardaki limit problemlerine çözüm üretmede zorlanmışlardır. RBC+C soyutlama modeli bağlamsal olarak tasarlanan problem çözme süreçlerinin analizinde etkili bir araçtır.

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INTRODUCTION

Limit is among the most basic concepts of calculus, as it is directly related to many important concepts such as derivatives, integrals, continuity, and approximation theory (Cornu, 1991; Gürbüz et al., 2018). Although Limit has the characteristics of a basic concept, only a tiny part of individuals in mathematics education can adequately understand the concept of Limit (Tall & Vinner, 1981; Sierpinska, 1987). Limit is a word of Latin origin used with various meanings; the number at which the images under the boundary, Limit, maximum scope, endpoint, and function are stacked in numbers close to this number for a certain number. In other words, knowing the Limit is a preliminary knowledge of many important mathematical concepts such as derivatives, integrals, continuity and convergence. For this reason, it has an important place in mathematics teaching and programs. For non-mathematics majors, the lack of understanding of the concept of limits may not be a severe problem for the study of advanced mathematics courses; however, mathematics students and teachers' understanding of Mathematics will significantly affect their ability to study further Analysis courses because all of these courses require Calculus as a prerequisite (Liang, 2016). Teaching Limit knowledge in calculus recently is viewed in two ways: the theoretical calculus used in applications, often based on the symbolism of Leibniz, enhanced by the work of Cauchy using infinitesimal techniques, and the formal mathematical analysis of Weierstrass based on quantified set theory (Tall and Katz, 2014).

As in the emergence of other mathematical concepts, the concept of Limit emerged in producing solutions to real-life problem situations and was developed by various mathematicians. Euclid and Archimedes are the first users of this concept. Archimedes used the concept of Limit while calculating the area of the circle. Archimedes began the process by placing regular polygons with increasing sides inside and outside the circle. As evidence, he uses the method of consumption, like the Ancient Greek geometers (this method can be seen as a primitive form of calculus). He continued with the calculation of the area of the triangle in any polygon. In his rationale, the area of the circle is associated with the area of a right triangle whose base is equal to the circumference of the circle and whose height is equal to the radius of the circle (Høyrup, 2019), and Archimedes calculated the lower and upper limits in this process (Cajori, 2014). Studies shaped the current use of the Limit in the 17th century. Fermat explains the reciprocal relationship between the Limit of a curve at a point on the graph and the tangent of that point of the curve (Baki, 2008, p. 147). In the following years, Newton and Leibniz used limits to calculate integrals. It has been realized that differential equations were born from Limit (Baki, 2014, p. 145). Cavalieri showed that the area under the curve in the range is the Limit (Baki, 2008, p. 146). Then, the current application in mathematics is the Limit definitions specified by Weierstrass and Cauchy (Arslan & Çelik, 2015). The epsilon-delta definition of the Limit is the formalization of the limit concept (Balcı, 2014).

The mathematical definition of the concept of Limit was expressed by Augustin-Louis Cauchy (1780–1857) as follows: “When values successively assigned to the same variable, when approaching a constant value forever, end up differing from it as little as desired, that constant is called the limit of all the others" (Dugac, 1973). Although Cauchy's definition of continuity and derivative in terms of Limit is relatively modern, it would be entirely wrong to say that "he gave the first true mathematical description of the limit and never needed modification." Another definition was made by Karl Weierstrass (1815–1897): “if for each there is at least one real number for the real numbers providing the inequality of such that, then is called the limit of the function at a point and is indicated by =” (Nakane, 2014).

Limits are not a simple matter, especially since they involve different operations involving infinity (Baştürk & Dönmez, 2011; Tangül, Barak and Özdaş, 2015; Gürbüz et al., 2018). The existence of infinite processes in the concept of Limit makes it difficult for students to understand the concept of Limit. Most students have difficulty making sense of Limit knowledge in their minds (Çıldır, 2012). Durmus (2004); Gürbüz, Toprak, Yapıcı and Doğan (2011); In Tatar, Okur, and Tuna (2008) mathematics lessons, the subject of Limit comes first among the subjects that students perceive as complex (Durmuş, 2004; Gürbüz et al., 2011). Revealing the difficulties in understanding the concept of Limit is valuable in terms of its relationship with other mathematical concepts, and there is a tendency in this direction (Baştürk & Dönmez, 2011). Teaching the concept of Limit within the scope of the Mathematics Lesson aims to provide students with skills such as calculating the limit values of various functions at a certain point and understanding the relationship between graph and graph. He uses the Limit of a function, the theorems of the concept of Limit, and can determine whether the Limit exists by formal definition. Undoubtedly, the ability of students to achieve these achievements depends on their having a sufficient conceptual understanding of the formal definition of the concept of Limit (Güven, Baki & Çekmez, 2012).

Studies on limit knowledge (Barak, 2007; Baştürk & Dönmez, 2011; Denbel, 2014; Juter, 2006; Szydlik, 2000; Tangül et al., 2015; Memnun et al., 2017; Gürbüz et al., 2018; Zollman, 2014) identify students' difficulties and misconceptions in limit learning. The misconceptions identified regarding the concept of limit were identified by Barak (2007) as epsilon-delta definition, limit definition, the limit of a function at a point, limits approaching from the right and left, the relationship between limit and continuity concepts, a function defined at a single point, graphing functions, understanding the concept of infinity and using the limit in equations. Denbel (2014) stated that university students have similar misconceptions that they see a limit point as unreachable, an approach, a limit or a dynamic process. Studies in the literature show that very few individuals adequately understand the formal definition of the concept of limit through instruction (Ervynck, 1981; Quesada et al., 2008). The fact that the definition of limit is too full and difficult to understand has led students to develop the idea of highlighting an informal definition and pushing the formal definition into the background in teaching the concept of limit (Fernandez, 2004; Gass, 1992). On the other hand, many researchers think differently and formally define the concept of limit as the main point of transition to abstract thinking, make

inferences about formal mathematical expressions and use formal proof techniques (Ervynck, 1981; Swinyard & Lockwood, 2007). Novak (1993) stated that the purpose of education is to direct students to meaningful learning. He defined meaningful learning as the necessity of making connections between newly introduced concepts and previous knowledge. Concept learning is defined differently for each approach. Some studies (Biber & Argün, 2015; Bukova-Guzel, 2007; Çıldır, 2012; Dönmez & Baştürk, 2010; Kula & Bukova-Guzel, 2015; Roh, 2007; Gürbüz et al., 2018) investigated how students learn about limits, and they included some teaching studies in order to eliminate the difficulties and misconceptions about limit knowledge. In the teaching of limit knowledge, teaching strategy (Akbulut & Işık, 2005; Dönmez & Baştürk, 2010), activity-based teaching (Akkoyunlu et al., 2003; Kula & Bukova- Güzel, 2015), technology use (Çıldır, 2012) and various mathematical It has been stated that attribution (Biber & Argün, 2015; Tangül et al., 2015) processes have a positive effect.

Our approach here is to explain the underlying nature of human perception and how our human aptitude for language and symbolism (the language of mathematics) leads to forms of mathematical abstraction in (unique) contextual situations. Recent theories of the development of mathematical thinking (Dubinsky, 1991; Gray & Tall, 1994; Sfard, 1991) focus on how humans carry out mathematical operations, such as addition, sharing, calculating the limit of a sequence, differentiation and integration. At each stage, we perform a process that occurs in time to produce an output that may also be conceived as a mental entity independent of time. Counting gives rise to the concept of number; the process of adding 3 + 2 gives rise to a mental concept, the sum, which is also written using the same symbol 3 + 2; sharing gives the concept of fraction; calculating a trigonometric ratio such as sin A = opposite/hypotenuse gives the concept of sine; the process of differentiation gives the derivative; and the process of integration gives the integral. In every case, a symbolic notation represents both a desired process and the resulting concept, such as 3 + 2, a(b + c). Gray and Tall (1994) refer to this conception of a symbol that dually represents a process or concept as a precept, with the additional flexibility that different symbols with the same output, such as a(b + c) and ab + ac, represent the same precept. Analyzing a sequence () given by a specific formula involves calculating a set of terms and observing how the process leads to a particular value - limit. Cornu (1981, 1991) described how students think of the shrinking process as producing an object that is itself arbitrarily small but not 0. Tall (1988) defined it as a general limit. What is meant to be expressed here is different from what the limit is, what it does or how it should be taught. The brain activity underlying this process is more fundamental. The connection from the perceptual world of our human experience to the computational world of arithmetic and algebra was initiated by Descartes and others. This paved the way for Newton and Leibniz to calculate naturally perceived phenomena, such as the measurement of length, area, volume, time, distance, velocity, acceleration and their rates of change and growth, using the computational and manipulable symbolism of calculus. Cantor and Weierstrass took the matter further by interpreting the number line in terms of number, arithmetic, order, and completeness symbolism. However, what radically changed the way we think about mathematical ideas was Hilbert (1900)'s introduction of formal axiomatic mathematics. He shifted attention from natural phenomena that we perceive physically and mentally to properties of phenomena. Axioms determine a mathematical structure, and deductions are made with mathematical proof. This frees mathematical thinking from the limitations of human perception to the possibilities of formally defined systems and their outcome properties (Tall and Katz, 2014).

Tall (2004, 2008) formulated three fundamentally different ways mathematical thinking develops, which are related both to the historical development of ideas and to the cognitive development of the individual from childhood to the mathematician: embodied, symbolic and formal. Mathematical ideas begin with perceiving the embodied world (Tall & Katz, 2014). Thought is refined through language's subtle experimentation to develop abstract concepts in an increasingly complex world of conceptual organization. Núñez et al. (1999) stated that the formal epsilon-delta continuum differs from the natural continuum based on human arrangement and perception. Lakoff and Núñez (2000), rejecting the views that mathematics is universal, absolute and precise, explained that this situation would make mathematics inaccessible even to students with other fundamental interests and skills.

This study aims to understand how pre-service teachers mathematically abstract the concept of limit in the face of problem situations that require solving with the limit expressed in life situations. In this respect, it is desired to examine the abstraction processes of pre-service teachers about how the examples of the limit given in living environments will be defined in the mathematical world. In the literature, processes such as didactically explaining the meaning of the concept of limit (Juter, 2006), examining the structures related to the concept of limit from an epistemological point of view (Bergsten, 2006), and constructing the limit in the mind of the individual (Gürbüz et al., 2018; Memnun et al., 2017) have been examined. In this study, the abstraction process of mathematical knowledge is examined. Previous mathematical knowledge is the tendency of an individual to respond to a perceived problem situation in a social context by constructing or organizing mathematical processes and objects in his mind to cope with the situation (Cottrill et al., 1996).

The theoretical basis adopted for this study and terms used in terminologies such as construction and schema is reflected. “The coordinated process scheme of a mathematical structure is difficult, and not every student can create it right away. As a result, a contextual limit problem design was created that focused on enabling students to construct "specific mental constructs" that are important for understanding the concept of limit. The research method is a cyclical process in which a genetic divergence is developed through an epistemological analysis. After extensive observation and student consultation, a renewed cycle can lead to design and, eventually, theory changes. In this way, it is desired to bring the research approach into a robust epistemological component that interacts with the cognitive approach.

It is influenced by PISA, TIMSS…**Etc** educational research in recent years; prospective teachers interested in contextually organized problems that have become more common in Turkish national ranking exams (required for secondary and higher education entry) such as LGS, AYT, TYT **Etc**. His skills are intriguing. It is desired to investigate the abstraction skills of the pre-service teachers regarding the contextually organized problems of the concept of limit. The abstraction process of the limit concept will be examined with the Abstraction in Context (AIC) theory for contextual problems. Among the abstraction theories, AIC was preferred because of its compatibility with contextual situations (Dreyfus, 2007; Gürbüz et al., 2018).

Contextual Limit/mathematic Concept

The role of contextualization in the understanding of science cannot be denied today. Various reform movements in education, such as mathematical literacy, science for all, critical thinking, constructivism and contextual teaching, can be seen as a reaction against the current way of presenting and organizing education. These movements often try to teach science content as well as science. Teaching science means teaching how science is developed and how one concept relates to another, not just the factual content of science. The idea of contextualizing the material taught has become a kind of consciousness for various reform movements.

A remarkable feature of his education is that, to a lesser extent known in other fields, it was conducted through textbooks, especially works written for students. Even books that focus on a single subject differ mainly in level and pedagogical detail, not in content or conceptual structure (Kuhn, 1963). Expressed for the constructivist approach, "Knowledge is not a commodity that is somehow outside the knower and can be transferred or instilled with a diligent perception, but the result of the constructive activity of an individual subject." (Glasersfeld, 1990, p. 37). According to this view, learning is a meaning-making activity in which the learner tries to place new information into existing mental structures. Where conceptual overlap or context is the dominant factor, new information is always linked to similar information. With this way of reasoning, the importance of context in the learning process comes to the fore, since information cannot exist alone in long-term memory, and even in the reasoning process, there are constant attempts to establish connections between concepts.

A context-based approach has its advantages (Tabach and Friedlander, 2008): It facilitates learning processes by giving real or concrete meaning to an abstract concept or algorithm. Provides reference points; when work is done at a more abstract level, it can create models that allow students to refer back at a later stage of learning. It increases student motivation and the student's willingness to participate in learning. It strengthens the potential to use algebraic models and skills in other fields. It is both a starting point for understanding the performance of concepts and operations in learning context-based mathematics, as opposed to simply applying instructions in the process of solving a problem. Context is the main process of this situation. Wiest (2001) defined the context as an important element in the construction of meaning from beginning to end and likened it to a ground that facilitates the meaning of parts. Gravemeijer and Doorman (1999) stated that a pure math problem can be contextual, in any case a contextual task must be experiential, real for the student, and serve as the basis from which a mathematical concept that is important can be built. Context plays a role in the learning process by creating real or concrete meanings for an abstract concept.

The act of applying conceptual knowledge learned in a context to solve a problem in a new (unfamiliar) context is called transfer or transfer (Ross, 1987). Studies have shown that transfer is a difficult process (Pan and Rickard, 2018). Students who are faced with new problem scenarios manage to realize their applicability in only 10-30% of the time (Norman et. al. 2007). Successful transfer process requires recognizing the structure of the abstract concept underlying the problem (Ross & Kennedy, 1990). Research on transfer should move away from the analogic reasoning paradigm to adopt a more ecologically valid use of analogies and context diversity during learning (Kulasegaram. et al. 2012). It aims to draw attention to the rich mathematical thinking generated when students work on contextual mathematization tasks. We use the RBC+C abstraction approach to create reporting methods that increase the visibility of this rich mathematical thinking and preserve and respect its complexity.

RBC+C Abstraction Model

Studies emphasizing conceptual learning more than procedural learning in limit teaching highlight mathematical abstraction (Gürbüz et al., 2018). In addition, examining the abstraction processes in teaching limit knowledge has gained importance (Memnun et al., 2017). In this respect, conceptual learning of a limit requires the abstraction process. For this reason, structuring issues, which require the examination of the abstraction processes of a concept in the minds of individuals, are important research topics in the learning field of mathematics. In addition, mathematics is a science of abstraction, and most mathematical concepts are obtained through abstraction (Altun, 2014, p. 5). This makes it essential to overcome the abstraction process of concepts, especially in mathematics education. For this reason, it is essential to determine how to develop abstractions and generalizations that students will realize with the help of their prior knowledge (Bukova-Guzel, 2006, 2007). For all these reasons, this study examines how pre-service mathematics teachers mathematize real-life knowledge in terms of the concept of limit and how they structure and abstract it in their minds for the same concept.

Abstraction is a structural process; It is the process of transforming mental structures in context into mathematical structures or constructing mathematical structures from mental structures. It isolates a concept based on its characteristics and directs a comprehension process from the context to a series of correct (Dreyfus, 2007; Mitchelmore, 2002; Sierpinska, 1994; Tall, 1988; Yılmaz, 2011). In mathematical abstraction, mathematical concepts are obtained as a result of a mental structuring process

(Gürbüz, 2021); in this respect, a transition between concepts is ensured, and understanding is provided through conceptualization rather than memorizing procedural knowledge (Can, 2011). For this reason, research on mathematical abstraction has an important place in mathematics education. Therefore, the theme of abstraction has an important place in mathematics education. Since the abstraction process is not directly observable (Dreyfus, 2007), it has become necessary to identify observable actions that provide information about the abstraction process. This model was defined as RBC (Recognizing, Building-with, and Constructing) Abstraction Theory by Hershkowitz, Schwarz, and Dreyfus (2001) to analyze mathematical abstraction processes. The Nested RBC Abstraction Model (Recognize, Construct, Build) Model emphasizes the need for abstraction and encouragement (incentive) in the process of creating (forming) the concept in mind. Hershkowitz et al. (2001) defined the epistemic actions of the abstraction process as recognizing, co-constructing and constructing. In RBC, it has been observed that when a person forms a concept in his mind, epistemic actions are ordered non-sequentially (Dreyfus, 2007). It is emphasized that the actions have a structure that can be intertwined and accommodate each other (Özmantar, 2005).

RBC+C (recognizing, building-with, construction and consolidation) abstraction model, which was developed and used to reveal the mathematical abstraction process from the context in the mind of the individual, reorganizes the old structures to reach a new structure, establishes connections and relations between them and establishes connections and relations between them and requires integration into a single thought process.

“Recognizing” in the RBC+C model is to attribute meaning to the mathematical structures in the learning environment by using the formal or informal information available in the individual's repertoire (Hershkowitz et al., 2001). This includes recognizing the structures that individuals are familiar with about the mathematical structure studied (Bikner-Ahsbahs, 2004; Hassan & Mitchelmore, 2006); in other words, it is the use of structures when necessary (Dreyfus, 2007).

In the process of "building-with" in the RBC+C model, individuals who need familiar structures to generate new knowledge create a viable solution to the problem by using their existing structural knowledge. This process, in which the act of building together is intertwined with the epistemic act of recognition, requires associating the known with the new content (Bikner-Ahsbahs, 2004; Hershkowitz et al., 2001). The construction of the individual with his action is a critical point in the abstraction process, and when it is not observed, it can give a clue that will activate him (Dreyfus, 2007).

In the RBC+C model, “construction” is the process of restructuring the known structures by making a partial change and creating new structures/meanings based on this action (Bikner-Ahsbahs, 2004). The reason is that the individual cannot construct a new structure without performing other cognitive actions using his knowledge and experience. Construction occurs due to the realization of the other two cognitive actions (Dreyfus, 2007). If the individual contemplates only a mathematical subject intensely, a structure will be formed (Dreyfus, Hershkowitz & Schwarz, 2001).

Depending on the problem, the same problem enables a student to perform the knowledge construction action, while another student can perform this process recognizing action (Gürbüz, 2021). In other words, the occurrence of these actions is not clear and precise. This depends on the student's past experiences, personal skills, and whether stimuli trigger the student's knowledge (Dreyfus et al., 2001). However, Dreyfus (2007) stated that new structures constructed using abstraction are fragile, making it difficult to maintain the new structure. Consolidation can occur when one person associates structures with another, uses structures to create a new structure and reflects on these structures. The act of combining can occur when students study well-known mathematical topics and, at the same time, use a situation or concept they have just abstracted for further abstraction (Dreyfus & Tsamir, 2004).

Hershkowitz et al. (2001) found that abstraction occurs during problem-solving in their study with ninth-grade students. Özmantar and Monaghan (2007) stated the factors affecting the abstraction process in their study of the absolute value function. Yeşildere and Türnüklü (2008) examined the effects of different mathematical forces on the abstraction process. The RBC + C model has been studied in different studies using various mathematical concepts: most enormous integer function (Altun & Yılmaz, 2008), properties of algebraic and arithmetic operations (Dreyfus et al., 2001; Gürbüz, 2021), ratios and proportions (Hassan & Mitchelmore, 2006), and probability (Dreyfus, Hadas, Hershkowitz & Schwarz, 2006; Hershkowitz, 2004; Schwarz, Dreyfus, Hadas & Hershkowitz, 2004). In addition, functions (Hershkowitz et al., 2001), absolute value (Özmantar, 2005), linear equations (Sezgin-Memnun & Altun, 2012), infinity (Tsamir & Dreyfus, 2002), and triangles (Yeşildere & Türnüklü, 2008) have also been investigated. In addition, the RBC+C abstraction model has been compared with Sfard's theoretical model, and the issues that the RBC+C model is effective in this process have been revealed (Gürbüz et al., 2018). It was decided to choose RBC during the analysis period since vital situations where the reason for the emergence of RBC, and the original theory was an abstraction from the context.

The Study Aim

First, it is an undeniable reality that as an experienced instructor of calculus courses for more than 32 years, understanding the concept of Limit is the basis for teaching concepts such as Continuity, Definite Integral, Differential Calculus, Etc. Higher Mathematics is more than reconsidering the epistemic actions of Recognizing and Construction in terms of continuity, integration, differentiability, Etc. and finding new properties and connections in the process of going from Recognizing to Construction or how mathematical thinking works in this process. In this context, it is another fact that if this critical concept is not fully learned, it will not be adequately understood in advanced concepts or only operationalized will be prioritized. This study is based on our previous study, which investigated how the concept of Limit changes operationally and conceptually in the individual's mind (Gürbüz et al., 2018); unlike operational thinking, is to motivate students to draw attention to their conceptual context-based understanding of

the concept of "limit" and to reveal abstraction processes in terms of RBC+C from this point of view. In a way, this study is a continuation of our previous study.

This study aims to reveal the realization processes developed by pre-service mathematics teachers for problems in which the Limit is organized contextually. It is thought that the abstractions developed by the pre-service teachers in this process will contribute to teaching the concept of Limit. In this context, the research problem is "How do prospective teachers abstract the concept of limit from contextually organized Limit problems?" has been determined. Answers were sought for the following sub-problems:

1. What is the abstraction of prospective mathematics teachers in contextually organized limit problems?
2. What are the situations that pre-service teachers have difficulty abstracting in contextually organized limit problems?

METHOD/MATERIALS

Lester (2005) reasons why educational research needs to be pursued within a scaffolding framework. A framework is here seen as "a basic structure of the ideas (i.e., abstractions and relationships) that serve as the basis for a phenomenon that is to be investigated" (p. 458), representing its relevant features as determined by the adopted research perspective, and serving as a viewpoint to conceptualize and guide the research. A research framework thus "provides a structure for conceptualizing and designing research studies," including the nature of research questions and concepts used and how to make sense of data. A case study, one of the qualitative research types, was used in this study. Since the research has descriptive and explanatory features (Yin, 2003) expected in a well-designed case study, it was concluded that this method is suitable for use. Case studies are suitable for examining a particular phenomenon in detail, such as a person, a process, an operation, or an institution. In qualitative case studies, the researcher(s) investigates a process, questions can address a situation description, and themes can be derived from it (Creswell & Creswell, 2017, p. 130). The situation in this research is a detailed examination of pre-service teachers' concept abstractions in contextually designed limit problems. The data obtained in case studies are vital in reality, and the findings are open to interpretation (Cohen & Manion, 1994). The data was collected with the course's instructor and a participant. Participant interviews were thought to help interpret mathematical thinking and abstraction during the interview. Therefore, it can be considered a descriptive case study that requires detailed information about a phenomenon to provide data for future comparative studies (Merriam, 2002).

The participants of this study are pre-service mathematics teachers at a university in the big city of Marmara, the geographical region with the most Universities in Turkey. 52 (30 female and 22 male) primary school mathematics teacher candidates constitute the sample of this research, which was carried out to reveal the ability of pre-service teachers to abstract from the context related to limit problems prepared in the contextual format during the Analysis-1 lesson. It was determined that the participants were first-year students studying in the primary school mathematics education program, and all the participants regularly attended the Analysis-1 course. Among all students, students from three success levels were determined for interviews with the purposeful sampling method. All three students are women. Evaluating the GPAs of the participants and the opinions of the course teacher, they were classified into three categories: good, moderate and mediocre. A random student was selected from each category, and interviews were conducted. In addition, these students participated in the study voluntarily. They had already learned the series and functions necessary to acquire limited knowledge. The students were given the nicknames Ayse, Fatma and Hayriye. The students in the study group of the research completed the calculus courses.

Data Collection Instrument

Although not all problems alone lead to an abstraction, the abstraction of a concept in the mind of the individual can only be realized in the problem-solving process (Hershkowitz et. al. 2001). For this reason, four contextual problems were designed by the researchers in order to determine the epistemic abstraction actions of pre-service teachers in the process of abstracting the concept of limit from the context. These problems are derived from the contexts that the participants may encounter in daily life in order to reveal the basic features of the limit concept, for example:

Question-1: Two people approaching a wall are talking, and they are telling each other about the numbers on the number line on the floor. How can they know where the wall separating these people is, this is an example of what mathematical concept? Briefly write the name of the concept and explain it.

i. How would you explain this situation in a mathematical language?
ii. When you consider the mathematical concept mentioned in this question, what is the advantage of the approximation method used to find the number under the wall? Why is this approximation method used mathematically?

Question-2: While traveling by car, the speedometer reads 85km/h. It shows the way to go in an hour. However, in the real world, your speed is constantly changing over time, and the only real information you have is that you have traveled 150 km from A to B in exactly 2 hours. The number your speedometer gives you is the limit at t_0 moment of your trip.

$$v(t_0) = \lim_{\Delta t \to 0} \left(1 + \frac{s(t_0) - (s(t_0 - \Delta t))}{\Delta t} \right)$$

Here it shows the distance traveled until the time. How would you explain the mathematical expression shown here to someone who doesn't understand? Please explain.

Question 3: Two friends are playing the game of keeping score. Ali kept the number c in his mind and his friend told him the number c+ δ. Ali, on the other hand, told his friend that the value of f(c+ δ) is "ϵ" higher than the value of f(c), which is the function value of the number it holds. At this time, his friend said the number c-δ, while Ali stated that the number he kept was as little as “ϵ” from the function value.

i. Express the situation expressed here with the limit using the δ- ϵ technique.

ii. Draw the limit graph showing your approach method.

Question 4: It is desired to make a rectangle with the largest area with 36 meters long wire.

Perimeter of Rectangle= 2w+2l=36

Length(w)	8	8.5	9	9.5	10
Area(a)	80	80.75	81	80.75	80

i. The limit value of the field will be 81 as the length “w” value approaches 9. Express the expression with the limit using the δ- ϵ technique.

ii. Explain why the "w" side must take the value 9 for the area of the rectangle to be the largest, using at least two of the graphs or expressions of f(w)=area,f(w).

All the designed contextual limit problems are related to the mathematics teaching department Analysis 1 course learning outcomes. Therefore, the problems are directed towards the abstraction of the limit concept.

The aim of the first problem is to know that the concept of limit can be approached from two different directions in the construction of epistemic knowledge, to explain the approach method with a mathematical language and to measure the conceptual reflection of the approach method, which is expressed mathematically. Pre-service teachers are expected to reflect their knowledge of the concept of limit in order according to the three epistemic actions of RBC.

The purpose of the second problem requires that the Limit information be explained with different representation tools. In this respect, pre-service teachers' demonstrations will show which of the RBC epistemic actions they will exhibit regarding the concept of Limit.

The purpose of the third problem is to enable them to apply the epsilon-delta technique to a contextual situation and to derive a complete mathematical definition from the contextual form of the limit. In this respect, the epistemic actions of the candidates with their solutions will be determined.

The aim of the last problem is to adapt the epsilon-delta technique from the contextual situation to the mathematical form, to show the epsilon-delta technique in mathematical form, and finally to associate the epsilon-delta technique with the context by showing it in geometric form. The purpose of the problems and the RBC+C epistemic actions that teacher candidates are expected to show in the problem-solving process was presented for expert opinion. The difficulty, sequencing, and epistemic indicators of the problems were rearranged in line with their suggestions and justifications.

Procedure

At the center of the research is the process of abstracting the concept of limit from the context of pre-service mathematics teachers. Semi-structured interviews and participant observations were used as data collection tools in determining the abstraction processes of the candidates. In accordance with the academic calendar, within the scope of the Analysis Course, education continued in accordance with the achievements until the midterm. Afterward, the purpose and scope of the research were explained to the participants in detail before the application was made. Then, the volunteers were determined, and the working group was determined. Interviews were held without any additional training for the candidates. The interviews were recorded with a voice recorder. Their responses to semi-structured forms and supplementary papers were collected. All records were analyzed as a whole. This is to allow the researcher to review them as often as he wishes, delaying a final decision until he is sure of which points to emphasize in the analysis process.

Data Analysis, Reliability and Validity

The data were analyzed and interpreted using descriptive analysis of students' answer sheets, audio recordings, and observer field notes. The purpose of the analysis is to organize the obtained data and present it by interpreting it within the theoretical framework. The data obtained for this purpose are described systematically and clearly (Yıldırım and Şimşek, 2016). At this stage, the dialogues recorded during the interview were listened to several times and translated into expressions/texts in the study.

These data were analyzed, and the findings were divided into meaningful categories. Accordingly, the RBC+C model was applied to the expressions in the abstraction process and these expressions were analyzed through the cognitive actions of this abstraction model. In this context, the themes used and determined in the analysis of written interview expressions are recognition, co-construction, construction, and reinforcement. In other words, these cognitive actions were observed and recorded collectively by two researchers independently in the solution of each problem. Definitions of these cognitive actions for the problems in this research and examples of these actions are given in Table 1. The analysis template prepared by the researchers for the interview questions was adapted from the study (Gürbüz, 2021).

Table 1. Cognitive Actions of the RBC+C Abstraction in Context Model

Epistemic Action	Indicator	Example
Recognizing	It includes formal or informal information that an individual has previously acquired. They are attributing meaning to mathematical elements in the teaching environment. It creates individual awareness about what kind of prior knowledge is needed to learn new information.	Recognition of limit information, The meaning of the right and left approaches in finding the limit, Relating the meaning of limit from context to epsilon-delta
Building- with	It is seen in the problem-solving process. It is an example of personal use of pieces of information that one already knows to create a workable solution to the problem. This is intertwined with cognitive epistemic actions.	The use of limit information to solve the first problem item i, Using the limit information in the equation to solve the second problem, In the third problem, the processes before the formation of the structure, Procedures before installing δ- ϵ technique to solve the fourth problem
Construction	It is to partially change the known structures or to create a new mathematical structure based only on preliminary information.	Constructing a new mathematical structure contextualized by using the epsilon-delta technique in the first items of the third and fourth problems, the formation of the formal definition of the limit.
Consolidation	It requires developing a new structure in the mental process. It is the elimination of the fragility of the new structure.	In the second item of the third problem, the formal definition of the limit is reinforced because a different notation is needed. In the second item of the fourth problem, the formal definition is reinforced in explaining a new situation.

Students use their prior knowledge to solve the limit problems presented in context. With this preliminary information, it is expected to perform building-with action for different purposes. Afterward, the thinking styles used in the process of constructing the limit knowledge of the students are revealed. The extent to which the students have created their limit information and the necessary preliminary structures are reported. Finally, interpretations were made according to the data in order to make sense of the findings explained. The relationships between these findings and the conclusions drawn are presented in detail.

In this study, triangulation and inter-interpretive reliability methods were preferred to ensure reliability (Lincoln & Guba, 1985). In order to provide triangulation, the suitability of the categories to the steps of the theory was determined comparatively by using the transcripts of the participants' written texts and audio recordings. While data from written texts were used predominantly to define the categories, audio recordings were used to validate the categories. For example, based on written texts, the appropriateness of the RBC model for epistemic actions was determined. The classifications took their final form after being confirmed with audio recordings. For inter-interpretive reliability, participants' predictions, observations and explanations were evaluated as raw data by two independent researchers. Researchers have assigned them to independent thematic categories in connection with the steps of the theory. After the coding, it was seen that the consensus of the researchers was over 85%. Researchers debated inconsistencies in these categories until a consensus was reached.

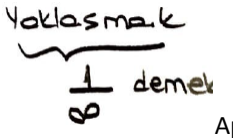
FINDINGS

The interview, which is the primary data source of the research, was carried out on pre-service mathematics teachers with three different success levels who participated in the research. During this 60-minute process, these participants worked on four different problems.

The first problem (approaching from the left and right to find the limit at a point) was prepared for finding the limit at a point. Participants are expected to recognize the limit in the contextual situation, and to remember an approach that uses finding the limit at some point. In item i, the remembered mathematical structure is expected to be expressed in mathematical language, that is, they are expected to exhibit the B epistemic action. In item ii, the answers of the participants determine the epistemic action they exhibit. This is the nature of RBC+C. If the advantage of the approach method used in the process of finding the limit is determined and the reasons for this approach are expressed mathematically, a C epistemic action can be observed.

Abstraction epistemic actions exhibited by students according to their problem solutions differed from each other.

Ayse 5: I think this concept is approximation. Approaching is for me the same thing as a half infinity.



Approaching = $\frac{1}{\infty}$ $mean$

Ayse 8: They are approaching point 33 from the right and left.

Fatma 3: Once the two say the numbers closest to the wall, it will be easy to guess the number in between. It is an example of approaching the limit from the right to the left.

…

Fatma 6: The two of them are very close to that number, but they cannot see that number and they get support from each other in this regard.

Hayriye 2: Instead of the wall, we can find it by saying the numbers as close to the wall as possible by the people on the right and left.

…

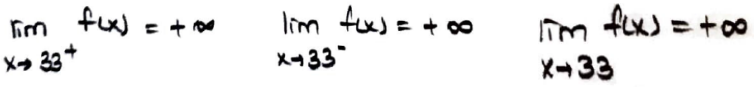
Hayriye 5: because we try to get it from the closest place as possible, not from a far place at the limit, so that the result can be found.

…

Hayriye 9: This is an example of the concept of limit in mathematics. If a limit variable x approaches a fixed-point c and f(x) approaches a value of L, it is said that the limit of “f” at point c is L.

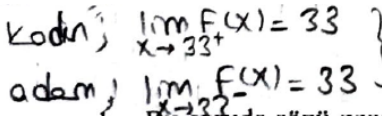
Three participants showed that they had limit knowledge. In addition, they all exhibit the epistemic action of R. While Ayse exhibited a simpler R epistemic action, Hayriye showed a more layered epistemic action regarding limit knowledge. Ayşe has defined the approach method more shallowly. This shows that his approximation method thinks that the function $f(x)$ will be meaningful only for the "∞" value of x. Hayriye, on the other hand, expressed a mathematical definition for the value of the Limit at a point. It gives rise to the idea that there is a dynamic point for all participants in finding the limit with the approach method. In item i of the same question, the epistemic actions of the participants in using limit knowledge were investigated.

Ayse 14: There is a limit at 33 points.



Ayse made the above-mentioned definitions without any explanation. Fatma did not show any mathematical expressions. Hayriye, on the other hand, made a limit definition based on the $f(x)$ function.

Hayriye16: These should be equal to each other so that we can reach a conclusion, but an important point is that the function does not have to be defined at that point, that is, 33 point in this question, I would like to point out that.



Participants were able to exhibit the Building-with epistemic action for finding the Limit with a right and left approach. However, only the good Hayriye exhibited a full Building-with epistemic action, while the participant in the mediocre category showed a deficient Building-with epistemic action.

In item ii of the same question, the structure expected to be revealed by the participants was investigated. However, the participants could not exhibit a full Construction epistemic action. They just exemplified this approach from their own repertoire.

Hayriye 20: There are some functions whose advantage cannot be found as a result. For example, when you write these functions, the value may not come, or there may be functions that go to infinity. The limit makes it very easy for us to find them.

Although a full Construction epistemic action has not been revealed, the participants stated that an existing known structure can be partially changed and its results. However, an action at this level was not observed for the participants in the average and

middle category. In general, the participants made experiential connections with their past knowledge in the process of constructing limit knowledge.

The second problem is the velocity-time variation in a given function $f(x)$. They were expected to find the limit of the function at the time t_0 expressed in the problem. The focus of the problem is the mathematical explanation of how to find the limit operation of the speed-time variation of a car in real life situation. Although the prominent abstraction process is seen as the Building-with epistemic action, a Construction action is expected in the reflective explanation. Naturally, this process is directly dependent on the answers given by the participants.

Ayse 30: To explain this to someone who doesn't understand, we need to simplify it. But I think it is at a level that cannot be simplified. I cannot simplify that expression in my head.

Hayriye 42: Usually we use the limit to find the current speed. While using the limit, we try to keep the velocity, that is, the time, close to zero so that we can calculate the current (it talks about t_0) as much as possible so that we can find the current result/speed.

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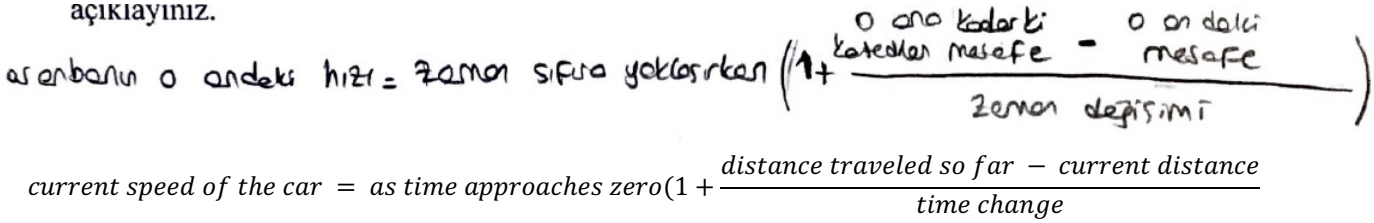


$$current\ speed\ of\ the\ car\ =\ as\ time\ approaches\ zero(1+\frac{distance\ traveled\ so\ far\ -\ current\ distance}{time\ change}$$

Hayriye 48: The speedometer gives us the speed we are going at that moment and while doing this, it uses the closest time interval.

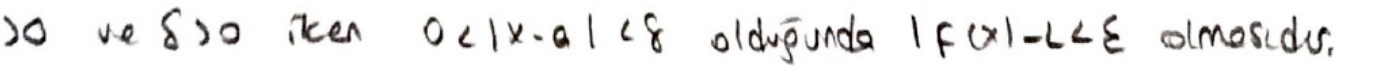
…

Hayriye 52: For this reason, when calculating the limit, Δt is indicated by an arrow as going to zero.

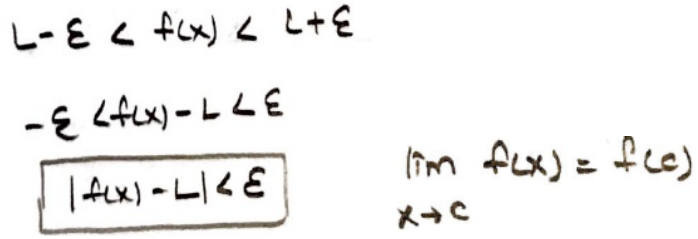
In this problem, only the participant in the good category was able to show a full Construction epistemic action. In other words, it is necessary to differentiate the function in the instantaneous velocity calculation. An explanation of how the function is derived using the limit is given by the participant. This shows that limit information can be used to create derivatives and can perform abstraction. Only the participant in the mediocre category could not reach this level.

In the third problem, one is expected to arrive at a formal definition of a limit using the $\delta - \epsilon$ technique from a contextual situation. Constructing a definition is a Construction epistemic act. However, if the preliminary information is written without expressing it in accordance with the contextual situation, only action B is exhibited. In the second item of the same question, they were asked to express the limit in a different form. The mathematical structures developed or constructed in the questions answered so far need to be brought together and expressed in a different mathematical notation. In this respect, consolidation action is expected depending on the answers of the participants.

When the answers given to the first item of the third question were analyzed, it was seen that the participants generally drew graphs in accordance with the known limit definition and tried to make a formal definition using the $\delta - \epsilon$ technique. For example, Fatma, who is in the middle category, defined a $f(c)$ function only for the c value in the abstraction process.



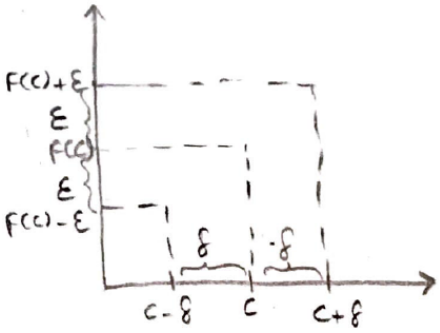
However, it is seen that he could not integrate the data related to the limit state, which was expressed contextually, in accordance with the definition. The process was completed as memorization by giving a definition. For this reason, it is seen that the limit information is only in the epistemic action dimension of using. Participant Construction, who was at the middle level in the abstraction of the contextually designed limit information, could not abstract in the epistemic action. Therefore, no Consolidation was observed. For this question, although only the participant in the mediocre category could do an appropriate Building-with to develop an appropriate abstraction, he did not exhibit an epistemic action at the Construction level and a complete abstraction did not occur.



Ayse 40: c is a point on the x-axis. As c - and c+, they are approached from the right and left. Δ is such a small number that one could say 0.0001. Afterwards, Ayse could not associate the contextual situation with the formal definition.

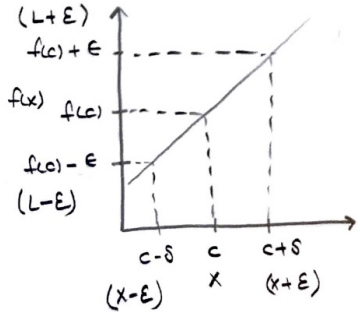
In general, the participants made solutions at the level of Building-with epistemic action and were able to express the formal definition. However, because they could not take an epistemic action at the Construction level, an abstraction did not emerge.

When the answers given to the second item of the third question were analyzed, it was seen that the participants were generally able to make an abstraction similar to the first item of the same question. In summary, it has been observed that they express the formal definition but cannot abstract from the contextual situation, that is, they show improvement at the operational level. A graphical representation of Hayriye is shown in the figure below.



Hayriye 64: I used deltas from the right and left of c. I said $c + \delta$ to the right of C. By the way, I wrote c on the x-axis. In short, I wrote $c + \delta$ on the c axis to the right of c and c-δ on the x axis to the left, and the value of $c - \delta$ corresponds to $f(c)-\in$.

When the answers given to the second item were analyzed, it was seen that they could make a clearer abstraction compared to the first item. Geometrically, the abstraction of the $\delta - \epsilon$ technique from the contextual situation was observed more clearly than the algebraic one. Ayse answered the same question with an approach that contains some errors in its content.

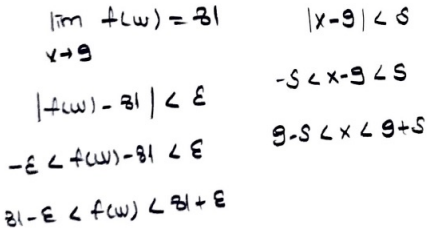


Although Ayse was able to construct the formal definition of the limit geometrically, she could not fully express the change in the $f(c)$ function in the $c - \delta$, c and $c + \delta$ intervals during the construction process.

Ayse 49: c is a point on the x-axis. As c - and c+, they are approached from the right and left. Δ is such a small number that one could say 0.0001.

Although Ayse has gone through a complete construction process, it is seen that she has done this with some knowledge deficiencies.

In the first item of the fourth and final question, they were asked to use a technique that was an application of the limit. In this process, the desired derivative is obtained with the limit. However, since the participants were able to operate with memorized information, a construction process did not emerge, and therefore an abstraction did not occur.



Ayse 69: I may have mixed up the $\delta \; and \; \in$ values. But in the end, both are very close to zero, so I don't think anything will change.

Ayse 79: I remember w and l must be close to each other for it to be the largest, after all, we found this using derivative.

Ayse could not make an abstraction in obtaining an implementation of the derivative using the limit. It has been observed that he remembers some of his prior knowledge correctly, thus exhibiting the epistemic action in the $\delta \; and \; \in$ techniques, although he could not obtain a function as in the second problem, despite placing the data correctly. In this respect, it is seen that he remained at the B level and could not reach the Construction level. On the other hand, Hayriye made similar transactions with Ayse. Similarly, epistemic action could be exhibited at the Building-with level.

In the second item of the fourth question, how they will relate the concept of derivative and limit and what kind of structure will emerge in this process are examined. Participants tried to reach the solution by finding the vertex of the function through the

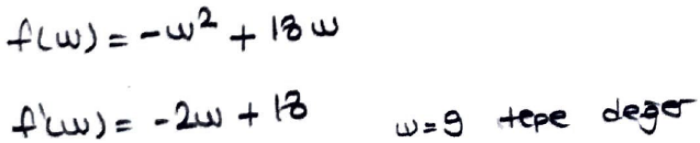
applications of the derivative. In general, instead of constructing limit information, they turned to applications of derivatives, which are memorized information.

Fatma 98: I went with the derivative first so that the area is the largest. I said that the derivative of f should have w=0.

…

Fatma 104: I took the derivative of the value in the field. In this derivative, w=9.

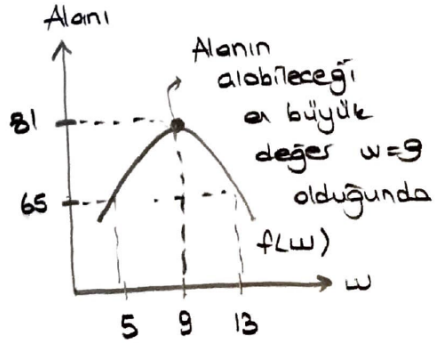
Ayse 90: Here we can take the derivative to find the maximum value of the field. coming out of here.



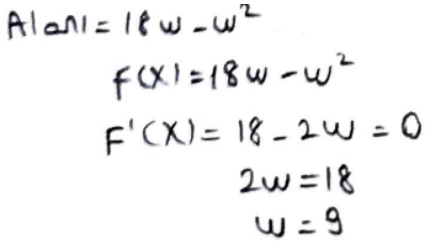
Ayse 96: At the peak value, namely 9, the area will have the largest value.

…

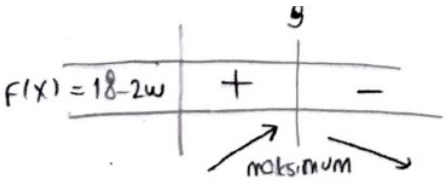
Ayse 100: When we show this graphically, we see that the peak is the highest at the point of the peak, that is, at the point 9, the area will have the largest value as 81.



Hayriye 108: The derivative of the function is usually used to find its maximum value. So this helps us with big and small area calculations. Its derivative became 18-2w. I set this equal to zero. 2w, 18 is out and w is 9 out of here.



Hayriye 112: However, it does not tell us that w is the maximum value. To prove that it has a maximum value, we need to draw a graph.



As can be seen from the answers of the participants in the last question, there was no abstraction for limit information. In general, the participants used derivatives and applications to reach the result.

DISCUSSION

In this study, the processes of abstracting the concept of limit from the contextual situation of pre-service mathematics teachers from three levels (good, medium and mediocre) were examined using the RBC+C abstraction model. The participants' processes of abstraction from context were examined using four main contextual research problems and sub-problem items on cognitive actions of recognition, co-construction, construction and reinforcement. These problems, designed by the researchers to reveal students' mathematical thinking levels and abstraction processes, enabled students to use their prior knowledge and to have a new structure.

The pre-service teachers who could construct the concept of limit in their minds in contextually designed problems were asked to form the approach method for the limit point obtained at one point and to explain the situation mathematically. At this stage, the step of knowledge came to the fore. However, in explaining the situation mathematically, examples from B+ and C steps are

seen. In general, it was observed that the participants could not provide an appropriate explanation for the C level, while they could easily do B+ at this stage. The general reason is that they do not build a complete abstraction of limit knowledge, and the experientially acquired knowledge needs to be assimilated.

The second question was asked in a form in which both the approximation method and the derivative were obtained from the limit information. The answers to the question showed that only the participants with good B+ knowledge, that is, able to practice more through experience could realize an abstraction. Although the participants' ability to practice a lot to perform abstraction has similar characteristics to the literature (Gürbüz et al., 2018; Bergsten, 2006; Sezgin-Memnun, 2017), it is seen that their ability to form a complete structure is weak. In the second item of the same question, all participants were able to explain the situation.

In the third problem, a well-known limit metro is tried to be abstracted. Although all participants completed their tasks successfully, it was observed that there were some information deficiencies in the explanation part, which affected the abstraction process. This incomplete information showed that in constructing the concept, the participants caused errors in transforming algebraic information into geometric information. The RBC+C abstraction model helped analyze and explain students' thoughts when some answers were unexpected or inconsistent with previous answers. It seemed natural to serve as an explanatory tool (Ron, Dreyfus, & Hershkowitz, 2010) for correct answers partially based on incorrect information and incorrect answers mainly based on correct information. In short, the participants exhibit some lack of knowledge even when they work on a well-known concept in the knowledge creation process. This situation affects the abstraction process. In the last contextual problem, all participants could abstract from the contextual situation using the technique. However, it has been observed that no C or C+ specific to their disclosure has occurred. In general, they construct a C in the form of the development of R and B+ epistemic actions. In the second item of the same problem, only the participant in the excellent category could perform an abstraction.

In contrast, the others were able to exhibit the b+ epistemic action. Mainly, the participants turned to concepts such as derivative and peak value in constructing limit information. One reason is that they use implementations of the derivative, which is an easier way of constructing limit information. While the participants were creating the mathematical structures they were expected to construct in the problem-solving process, they tended to create new structures based on the structures they knew by heart rather than forcing their minds.

The RBC+C abstraction model proved to be helpful in the process of explaining the path to soft information as opposed to just learning. Hayriye, who has a high level of mathematical success, structured her limit knowledge as a result of the analysis of this abstraction model's cognitive actions of recognizing, co-constructing, constructing and consolidating. Here, the structuring process of knowledge is an abstraction. Participants at all levels could demonstrate appropriate epistemic actions regarding using limit information presented in context. However, there has yet to be a complete success in writing this contextual limit information in mathematical form, and thus in the opportunities that allow abstraction away from memorized information. This shows that the development of students' mental structures confirms these cognitive actions. In related studies (Altun & Yılmaz, 2008; Sezgin-Memnun et al., 2017; Gürbüz et al., 2018) that focused on the abstraction of limit information in Turkey, students generally stated that they formed the concept within themselves. In addition, it can be stated that the participants of this study do not have misconceptions about limit knowledge. This confirms that pre-service mathematics teachers have had an effective learning process for limit knowledge.

However, the participants had difficulties transferring the contextually designed limit information to a new situation, giving a complete mathematical explanation, and explaining the limit information mathematically beyond memorization. For this reason, except for Hayriye, who is at a reasonable level, the others could not achieve a complete abstraction. Although similar results were obtained in Roh's (2007) study, participants needed help in a complete abstraction of limit knowledge in learning processes organized with contextual problem-solving activities. Although most participants were successful in the questions containing the active part of the limits, they could not achieve the same success in the questions containing the conceptual part. This research result is like the literature studies (Barak, 2007; Queseda et al., 2008; Güven et al., 2012; Gürbüz et al., 2018). It was observed that the participants exhibited the building with epistemic action better, but they had much difficulty constructing epistemic action. This may be because conceptual learning and procedural learning are not balanced in mathematics, there is more conceptual learning than procedural learning, and therefore students cannot apply the concepts or definitions they learn in mathematics lessons (Soylu & Aydın, 2006).

CONCLUSION

Under its nature, it was used to investigate the process of structuring limit knowledge in the minds of pre-service teachers through the RBC+C model of the process of abstracting mathematical knowledge from a contextual situation. In this process, it was repeated that the RBC+C model was helpful in determining the components of limit knowledge in the minds of pre-service teachers. It was determined that the pre-service teachers interviewed developed an understanding of limits and needed help using this concept in mathematical operations. However, they had difficulties transferring the limited information presented in context to new situations and explaining and proving it mathematically. In addition, it was found that they had difficulty adapting the formal definition to the new situation when faced with a contextual situation in which they could make a formal definition of the limit. Pre-service teachers understand the formal definition of memorization. However, it has been observed that a specific conceptual schema is formed in their minds. This shows that they cannot form the limited information in their minds entirely. In

summary, although the pre-service teachers could show different representations of the definition of the limit in the solution of the limit problems designed contextually, they could not comment on the variables in the definition. They could not construct a unique mathematical structure.

Declaration of Conflicting Interests

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The first author played an active role in writing the conceptual framework and discussion conclusions of the research, and the second and third authors played an active role in the data collection and analysis process.

Ethics Committee Approval Information

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| Research Article / Araştırma Makalesi|

Evaluation of Primary School Teachers' Questioning Skills Regarding Teaching Geography Subjects According to Revised Bloom's Taxonomy

İlkokul Öğretmenlerinin Coğrafya Konularının Öğretimine İlişkin Soru Sorma Becerilerinin Yenilenmiş Bloom Taksonomisine Göre Değerlendirilmesi

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Keywords

1. Finding location and direction
2. Questioning skills
3. Teacher
4. Revised Bloom's Taxonomy

Anahtar Kelimeler

1. Yer ve yön bulma
2. Soru sorma becerisi
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Abstract

Purpose: The main purpose of geography teaching in primary school is to give students a geographical identity, to introduce and make sense of the local and global environment. Qualifying questions and geographical inquiry skills play an essential role in achieving the goals as mentioned above of geography. The purpose of this research is to determine the level of primary school teachers' questioning skills for teaching place and way-finding gains in terms of Revised Bloom's Taxonomy. The revised Bloom Taxonomy consists of six categories: knowledge, comprehension, application, analysis, synthesis, and evaluation.

Design/Methodology/Approach: The research was carried out based on the document analysis pattern, one of the qualitative research methods, by following per the purpose of the study. The research was carried out with 32 primary school teachers working in public schools in different provinces of Turkey in the 2020-2021 academic year. To collect data in the research, the "Questioning Skill Form about Finding Place and Way-finding Gains" was used. A total of 426 questions prepared by the teachers were analyzed by descriptive analysis in terms of the cognitive process dimension of the Revised Bloom Taxonomy.

Findings: In line with the data obtained and the analyzes made, determined that the questions prepared by the teachers for the location acquisitions were at a low cognitive level. In addition, determined that the questions prepared by the teachers were mainly for the steps of understanding, remembering, and applying, respectively.

Highlights: Within the scope of the results obtained, suggestions are offered for primary school teachers' tendency to create more questions about high-level cognitive areas in the teaching of place and direction, which is a functional subject, and for further research.

Öz

Çalışmanın amacı: İlkokulda coğrafya öğretiminin temel amacı, öğrencilere coğrafi kimlik kazandırmak, yerel ve küresel çevreyi tanıtmak ve anlamlandırmaktır. Coğrafyanın sözü edilen amaçlarına ulaşmasında nitelikli sorular, coğrafi sorgulama ve mekânı algılama becerisi önemli rol oynamaktadır. Bu araştırmanın amacı ise ilkokul öğretmenlerinin yer ve yön bulma kazanımlarının öğretimine yönelik soru sorma becerilerine sahip olma düzeylerinin Yenilenmiş Bloom Taksonomisi açısından belirlenmesidir. Yenilenmiş Bloom Taksonomisi bilgi, kavrama, uygulama, analiz, sentez ve değerlendirme olmak üzere altı kategoriden oluşmaktadır.

Materyal ve Yöntem: Araştırma, çalışmanın amacına uygun olarak nitel araştırma yöntemlerinden doküman incelemesi deseni temel alınarak gerçekleştirilmiştir. Araştırma, 2020-2021 eğitim öğretim yılında Türkiye'nin farklı illerindeki resmi okullarda görev yapan 32 ilkokul öğretmeni ile gerçekleştirilmiştir. Araştırmada veri toplamak amacıyla "Yer ve Yön Bulma Kazanımlarına İlişkin Soru Sorma Becerisi Formu" kullanılmıştır. Öğretmenler tarafından hazırlanan toplam 426 soru Yenilenmiş Bloom Taksonomisinin bilişsel süreç boyutu açısından düzeyleri betimsel analiz ile çözümlenmiştir.

Bulgular: Elde edilen veriler ve yapılan analizler doğrultusunda, öğretmenlerin yer yön kazanımlarına yönelik hazırladıkları soruların düşük bilişsel düzeyde olduğu tespit edilmiştir. Ayrıca öğretmenler tarafından hazırlanan soruların sırasıyla en fazla anlama, hatırlama ve uygulama basamaklarına yönelik olduğu belirlenmiştir.

Önemli Vurgular: Elde edilen sonuçlar kapsamında ilkokul öğretmenlerinin, işlevsel bir konu olan yer ve yön konusunun öğretiminde üst düzey bilişsel alanlara yönelik daha fazla soru oluşturma eğiliminde olmalarına ve sonraki araştırmalara yönelik öneriler sunulmaktadır.

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INTRODUCTION

Education is a process that covers many elements and complements real life. The educational program included in the educational process consists of four essential elements: goals, content, learning-teaching strategies, measurement, and evaluation. Although dynamic relationships exist between these items, changing one thing also affects other items. In this context, the objectives item is essential in being a starting point for different things. The taxonomies, which emerged in the 1950s and 1960s in the determination of targets, attracted attention worldwide and became an indispensable element (Bümen, 2006).

Taxonomy, which plays an essential role in the development of curricula, is the gradual ordering of desired behaviors or achievements from simple to complex, from easy to difficult, from concrete to abstract, and to be interconnected (Sönmez, 2004). In this context, researchers made classifications. The most widely accepted of these classifications is the taxonomy of the cognitive learning field developed by Bloom in 1956. Bloom's Taxonomy has a hierarchical order and progresses from low mental levels to high mental levels (Birgin, 2016). Bloom's Taxonomy comprises six categories: knowledge, comprehension, application, analysis, synthesis, and evaluation. These categories aimed to classify the education programs of teachers, administrators, experts, and researchers, questions about assessment and evaluation, and education system objectives (Amer, 2006). Bloom's Taxonomy has been revised due to the differentiation of education-teaching approaches within the framework of developing and changing conditions, enabling educators to refocus on the original taxonomy and the need to combine current information about development and learning psychology, teaching methods and techniques, measurement and evaluation with this taxonomy. Due to the reasons mentioned above, the Bloom Taxonomy was renewed in 2001 by the working group chaired by Anderson and Krathwohl (Bümen, 2006; Önlen, Tatan & İbret, 2020; Tutkun, Demirtaş, Arslan & Gür Erdoğan, 2015).

When the changes in the revised classification are examined, there has been a transition from one dimension to two dimensions: "Knowledge Dimension" and "Cognitive Process Dimension." In the knowledge dimension, “Factual Knowledge” (Basic elements that need to be known, discipline/solving problems), “Conceptual Knowledge” (Relationships that enable the essential elements in a large structure to work together), “Procedural Knowledge” (How to do something, questioning methods, skills, techniques, criteria for using methods), "Metacognitive Knowledge" (Metacognitive knowledge and awareness and knowledge of one's cognition). The categories in the cognitive process dimension are preserved as six categories, as in the original number of categories. However, the instructional objectives (categories) are formulated from nouns to verb forms (remembering, understanding, applying, analyzing, evaluating, and creating). In addition, three categories were renamed (Knowledge: Recall; Comprehension: Understanding; Synthesis: Creation), and the order of two categories (Synthesis/evaluation by creation) was changed (Amer, 2006; Krathwohl, 2002). The Revised Bloom Taxonomy, which was put forward after the changes, is shown in Appendix 1. In the revised taxonomy, the expression of targets becomes essential.

In addition, using the taxonomy table allows educators to learn what can be done by noticing the empty (not filled) cells in the table (Bümen, 2006). In this context, it can say that the Revised Bloom Taxonomy is a vital planning, measurement, and evaluation tool based on the constructivist approach (Birgin, 2016). Curricula based on a constructivist approach provide alternative assessment and evaluation methods that measure high-level thinking skills (Arseven, Şimşek & Güden, 2016). First, it is essential to teach students to think to develop higher-order thinking skills. In this context, questions are essential elements of a process that enables and activates thinking and requires expression. Because seeking answers to questions requires mental processing (Erdoğan, 2017; Şanlı & Pınar, 2017). Therefore, we should create a question of different types to enable higher-order thinking skills. Skills within the scope of creating, asking, and answering questions play an important role in creating a research-based learning environment. It is also essential in raising inquisitive individuals.

The questions asked by the teachers determine to what extent the students have achieved the targeted achievements. In this sense, the question is the most excellent assistant of teachers in the learning and teaching process. In addition, it can say that it is one of the essential tools that enable students to assume the role of a tiny scientist and to be cognitively active in the course process (Çakıcı, Ürek & Dinçer, 2012; Çalışkan, 2011). On the other hand, asking the right questions in the learning process is more important than giving the correct answers (Yavuz, 2020). When teachers ask appropriate and practical questions, the learning process will start by itself. In addition, the essential element in gaining cognitive behaviors is the questions asked. Teachers must ask students questions at different levels (starting the lesson, developing, etc.).

In measuring student achievement, teachers should ask qualified and quality questions that can measure learning at different levels. In this sense, qualified and quality questions play an important role in ensuring the active participation of students in the lesson, keeping the interaction and communication active between teacher-student and student-student, and facilitating the learning of the subjects covered by students (Çalışkan, 2011; Doğru, 2022; Koç, Sönmez & Çiftçi, 2013). The effects of meaningful, remarkable, and arousing questions about the subject are excellent for the course to pass in a quality process. Especially for primary school students who are at the age of learning by asking, the answers given by the teachers during the lesson are essential in terms of their cognitive development. To complement this process, teachers should also ask qualified and high-quality questions their students. Geography teaching within the scope of various courses in primary school should be developed with questions and skills that require students to examine the local and global environment (Catling, 2001).

Geography education in primary school is carried out in life studies and social studies courses. The geography acquisitions in these courses aim to present information and facts about the world, provide students with positive attitudes and behaviors toward their environment, and provide them with cognitive skills (Demirbaş & Demir, 2018). In addition, geography teaching given in the

primary school age ensures that the students gain identity, perceive, recognize and make sense of their environment (Alaz, 2009). Thus, geographical development, sense of place, awareness of the world, positive attitudes, and values are developed in students. While informing students about people, places, and environments, they are provided with a more thoughtful and positive approach to these elements (Catling, 2001). In this context, I can teach geography in primary school by gaining geographical knowledge, geographical inquiry and spatial perception skills.

First, the correct answer to the questions in the geographical query depends on the correct and reliable geographical information. Geographical information is a place's physical and human geographic characteristics. Geographical inquiry skill, defined as the evaluation of events and objects in the world from a geographical perspective, has an important place in geography teaching. In this context, teachers should encourage students to be interested in the geographical events and objects around them by highlighting their curiosity. In addition, they should ensure that they systematically research the answers to these questions by asking geographical questions about these elements. When geographic inquiry becomes a habit by primary school students, it will become effective in the educational process. It will be beneficial in producing solutions to the geographical problems they may encounter after education. The ability to perceive space is a prerequisite for finding a place and direction. Students need to acquire the skill of perceiving the place in terms of being able to determine a location, find a place and direction, adapt to the environment, comprehend the geographical information about the place and use geographical questioning skills in their daily lives (Demirci, 2006; Doğru, 2022; Safi, 2010).

The first step of teaching geography in primary school can be arousing students' curiosity. In this context, the questions asked by primary school teachers to students should be of a quality that can give them a different perspective. These questions lead to students' formation and development of scientific inquiry and geographical inquiry skills. For this reason, it is essential to prepare the questions asked in taxonomy to achieve quality and a standard (Topçu, 2017). Therefore, we can use the Revised Bloom Taxonomy in deciding the level of the questions used while the acquisitions related to finding the place and way-finding in the life studies and social studies lessons in primary school are given to the students. In addition, the classification of the questions asked for these gains that are planned to be gained should be done following the mental development of the students. The levels of the prepared questions according to the Revised Bloom Taxonomy should be known by the teachers (Gündüz, 2009).

In the research, it is understood that the teachers prepare questions without considering the level of course outcomes and the Revised Bloom Taxonomy (Şanlı & Pınar, 2017, p. 958). For this reason, for a question to be included in the education process effectively for students and teachers, it is necessary to consider specific criteria and to have knowledge about measurement and evaluation (Topçu, 2017). The teachers need to prepare the questions they prepared by considering the Renewed Bloom Taxonomy in terms of developing high-level thinking skills such as problem-solving, research, and critical and creative thinking (Uymaz & Caliskan, 2019). Researching the revised Bloom Taxonomy in different classes and courses is necessary for our education system (Bümen, 2006). In this context, it is essential to analyze the teachers' questions to understand the students' mental processes and determine their learning levels. In addition, analyzing the questions is also essential in determining the level of asking teachers questions (Çalışkan, 2011, p. 122).

According to the Revised Bloom Taxonomy, there are limited studies on the evaluation of questioning skills on geography topics in the literature. For example, geography lesson was written exam questions (Arseven, Şimşek, & Güden, 2016); The questions in the 9th-grade geography textbook and various geography exam questions (Geçit & Yarar, 2010) and the 9th and 10th-grade geography curriculum outcomes (İlhan & Gülersoy, 2019; Sözcü & Aydınözü, 2019) were evaluated according to the Revised Bloom Taxonomy. When the studies are examined, it is seen that there is a need for a qualitative study to evaluate the level of questioning skills of primary school teachers about geography. At the same time, there is a need to determine the levels of written exam questions at the secondary education level. Unlike other studies, this research is considered necessary in analyzing the levels of questions according to the Revised Bloom Taxonomy and determining the levels of questions asked by primary school teachers in teaching location and direction subjects in particular. In addition, it is thought that the research will also benefit the measurement and evaluation research in geography teaching in primary school.

This research aims to determine the cognitive levels measured by the questions by analyzing primary school teachers' ability to ask questions about geography acquisitions in terms of Revised Bloom's Taxonomy. Within the framework of this purpose, "Which cognitive process dimension level of the Revised Bloom Taxonomy is included in the questions asked by the teachers about the subjects of finding a place and way-finding?" search for an answer to the question.

METHOD

Research Model

The research is analyzed according to the Revised Bloom Taxonomy of the questions asked by primary school teachers about the acquisition of place and direction from geography subjects within the scope of life studies and social studies courses. Since it is a study that determines the cognitive process dimension of the questions, it features document analysis from qualitative research methods. Because document review is a research method that enables the examination of written and visual materials containing information about the phenomenon or facts that are intended to be investigated, according to a particular system (Yıldırım & Şimşek, 2016), the research documents consist of forms in which teachers should write questions about each acquisition.

Study Group of The Research

The research study group consists of 32 primary school teachers working in public schools in various provinces of Turkey by using easily accessible case sampling, one of the purposive sampling methods. In this sense, easily accessible case sampling provides an opportunity to speed and practice the research and to select participants who are close to the researcher and easy to reach (Yıldırım & Şimşek, 2016). Demographic information of the teachers participating in the research is given in Table 1.

Table 1. Demographic information on the study group

Gender	**n**
Female	26
Male	6
Age	**n**
20-25	1
26-30	7
31-40	12
41 years and older	12
Education status	**n**
Associate Degree	3
Undergraduate	27
Graduate	2
Professional experience	**n**
1-5	5
6-10	7
11-15	10
15 years and above	10

As seen in Table 1, 26 of the teachers are female, and 6 are male. One of the teachers is between 20-25 years old, 7 of them are between 26-30 years old, 12 of them are between 31-40 years old, 12 of them are 41 years old and older. Three of the teachers have an associate degrees, 27 undergraduate, two graduate, and 5 of them are 1-5 years, 7 of them are 6-10 years, 10 of them are 11-15 years, 10 of them are 15 years. And above professional experience.

Data Collection Tool and Data Collection

The research used “Questioning Skill Form Regarding Place and Direction Finding Outcomes” as a data collection tool. The first part of the form created by the researchers consists of the personal information of the participants, and the second part consists of the acquisitions and question writing area. In the second part of the form, teachers were asked to create at least one question regarding the acquisitions related to geography in the Life Studies (1st, 2nd, and 3rd grade) and Social Studies (4th grade) Curriculums. The achievements used in the form are given in Table 2 (MEB, 2018a, 2018b). While determining the achievements, I thought that it would be troublesome and challenging to write the questions about the achievements for all geography subjects, and only the achievements for the subject of finding a place and direction were determined in line with the expert opinions (1 geography educator, two social studies educators).

Table 2. Acquisitions used in the form

Class to Which the Achievement Belongs	**Lesson to Which the Acquisition Belongs**	**Acquisitions**
1th Class	Life science	1.2.3.Describes the location of his/his house.
1th Class	Life science	1.6.6.Observes the Sun, Moon, Earth, and stars.
2th Class	Life science	2.5.1.Shows his/her country, capital, and place of residence on the map and globe.
2th Class	Life science	2.6.8.It shows directions by observing the sun.
3th Class	Life science	3.1.5.Their sketches her class and school.
3th Class	Life science	3.2.3.Draws a sketch of the place where the house is located.
3th Class	Life science	3.6.3.Their finds directions by taking advantage of nature.
4th Class	Social studies	4.3.1.It makes inferences about the location of any place around it.

The created form aims to determine primary school teachers' ability to ask questions about location and direction determination in terms of the cognitive process dimensions of the Renewed Bloom Taxonomy. To ensure the intelligibility of the form, made a pre-application with 2 class teachers. After made the necessary corrections, collected the data online with the

prepared form. After the researchers prepared the online form, shared its link (internet connection) with the teachers. Collected the data from primary school teachers working in public schools in various provinces of Turkey in the 2020-2021 academic year. Teachers participated in the research by filling out the prepared form.

Analysis of Data

In the research, analyzed the questions written by the teachers about the achievements by examining each question statement to determine its place in the Revised Bloom Taxonomy, and analyzed its place in the cognitive process dimension with descriptive analysis. Descriptive analysis summarises and interprets of the obtained data according to predetermined themes. The descriptive analysis takes place in four stages (Yıldırım & Şimşek, 2016). The data obtained from the research were analyzed by following the steps given in Figure 1.

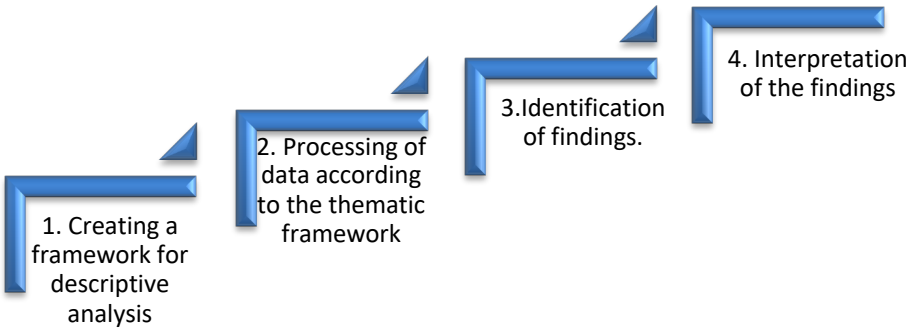

Figure 1. Stages of descriptive analysis of the data obtained from the study

The first stage of data analysis from the research created a framework for descriptive analysis. In this context, cognitive process dimensions of the revised Bloom's Taxonomy were used to analyze the data (See Appendix 1). In the second stage, the data were processed according to the thematic framework.

First of all, examined the expressions of the questions prepared by the teachers for the achievements discussed within the scope of the determined framework. In this context, which categories of "remembering, understanding, applying, analyzing, evaluating, and creating" were appropriate within the scope of the "Cognitive Process Dimension" of the revised taxonomy were evaluated. A total of 426 questions were analyzed and classified according to the revised Bloom's taxonomy. The third stage of descriptive analysis is the identification of the findings. At this stage, information and cognitive process dimensions of each question examined according to taxonomy were determined, and frequency (f) and percentage (%) rates were given and included in the relevant tables. The sample questions prepared by the teachers regarding the data obtained from the examinations are included. While quoting the sample questions, the teachers (T-1) were coded as "T-Number." The final stage has been passed with the interpretation of the findings. At this stage, interpretations and explanations were made for the findings.

Validity and reliability of analysis of data

To ensure the internal validity of the data obtained from the research, the teachers wrote expert opinions and examples of questions. The researchers wrote the external validity of the study by describing all stages of the research process and the data obtained in detail.

To ensure the internal reliability of the data analysis, researcher triangulation was used. Accordingly, data classification was made by a different researcher (Patton, 2014) and, in addition, calculated the reliability formula "[Reliability = Consensus / (Agreement + Disagreement) x 100]" proposed by Miles and Huberman (1994) for qualitative data analysis. Accordingly, “Reliability = 79%” was determined, and the data analysis was accepted as reliable when the result was over 70% (Miles & Huberman, 1994). On the other hand, external reliability was provided by confirming the results obtained by the researchers with the data obtained.

FINDINGS and COMMENTS

In this section, the findings obtained from the analysis of the questions prepared by primary school teachers through descriptive analysis are included. In the study, examined the taxonomy of the questions asked by the teachers, frequency and percentage distribution according to the cognitive process dimension and the result is given in Table 3:

Table 3. Frequency and percentage distribution of the questions asked by primary school teachers according to the cognitive levels of the revised bloom taxonomy

Cognitive Process Dimension	Frequency (f)	Percentile (%)
Remember	152	35,7
Understand	193	45,3
Apply	80	18,8
Analyze	1	0,2
Evaluate	-	-
Create	-	-
Total	426	100

When Table 3 is examined, it is seen that 35.7% of the questions asked by the teachers are at the remembering level, 45.3% at the comprehension level, 18.8% at the application level, and 0.2% at the analysis level. It observed that teachers asked very few questions at the level of analysis, which is one of the higher cognitive levels, and did not ask questions at the level of evaluation and creation.

In the study, examined the questions asked by the teachers according to the renewed Bloom Taxonomy, and the results of the cognitive level of the questions regarding the achievements are given in Table 4:

Table 4. Distribution of questions asked by primary school teachers according to achievements and revised bloom taxonomy

	Cognitive Domain Levels						
Gains	Remember	Understand	Apply	Analyze	Evaluate	Create	Total
Describes the location of her/his house.	21	24	9				54
Observes the Sun, Moon, Earth and stars.	24	21	1				46
Shows her/his country, capital and place of residence on the map and globe.	23	21	7				51
Shows directions by observing the sun.	22	23	10	1			56
She draws a sketch of her/his class and school.	11	26	20				57
Draws a sketch of the place where the house is located.	7	28	21				56
Their finds directions by taking advantage of nature.	22	27	8				57
Makes inferences about the location of any place around it.	22	23	4				49
Total	152	193	80	1			426

When Table 4 is examined, the teachers asked questions addressing 426 cognitive levels related to eight acquisitions. “Describes the location of your house.” It is seen that 21 of the questions prepared for the learning outcome are at the level of "remembering," 24 of them at "understanding," and 9 of them at the level of "application." “Observe the Sun, the Moon, the Earth, and the stars.” It was determined that 24 of the questions prepared for the learning outcome were at the level of "remembering, and 21 of them were at the level of "understanding" and "application." “Shows his country, capital and place of residence on the map and globe.” While 23 of the questions prepared for the learning outcome were at the level of "remembering," 21 of them were at the level of "understanding," 7 of them were at the level of "application." “By observing the Sun, he shows directions.” It is seen that 22 of the questions prepared for the learning outcome are at the "remembering" level, 23 at the "understanding" level, ten at the "application" level and one question at the "analysis" level. “She draws sketches of her class and school.” It was determined that 11 of the questions prepared for the learning outcome were at the level of "remembering," 26 of them were at the level of "understanding," and 20 questions were at the level of "application." “Sketches of where the house is located.” It was determined that 7 of the questions prepared for the learning outcome were at the level of "remembering, 28 at the level of "understanding," and 21 at the level of "application." “Finding directions by taking advantage of nature.” While 22 of the questions prepared for the learning outcome are at the "remembering" level and 27 at the "understanding" level, it is seen that eight questions are at the "application" level. “It makes inferences about the location of any place around it.” Of the questions prepared for the learning outcome, asked 22 at the level of "remembering, 23 at the level of "understanding," and four at the level of "practice." It determined that among the questions asked by the teachers, asked only one question at the "analysis" level, and asked no questions at the "evaluation" and "creation" levels, which are among the higher cognitive levels.

The questions asked by the teachers in the research were analyzed considering the Revised Bloom Taxonomy and placed in the appropriate category. Randomly selected examples of questions prepared by teachers according to cognitive levels are given below:

Examples of questions in the remembering level:

"Can you describe your house to your friends without using an address?" (T1)

"If we stretch our right hand in the direction of the rising sun, which direction will we face?" (T16)

"Which structures are located in the east and north of our school?" (T16)

"What do we see when we look at the day/night sky?" (T32)

Examples of questions at the comprehension level:

"Observe the sunset and tell us the direction of our school and what is happening to its north." (T3)

"Where is our country in the world model?" (T12)

"According to the sketch, what is east of Ayşe's house?" (T18)

"Draw a map and write down the city, country, and capital you live on." (T18)

"Write by describing the most used way-finding methods." (T28)

Examples of questions at the application level:

"Sketch of the floor where our classroom is located by using the floor plan on each floor of our school." (T2)

"Sketch where you live." (T2)

"Write the Sun, Moon, and Earth in order of magnitude and draw their shape." (T14)

"Sketch your house and indicate which road you can take to school closest to you." (T24)

Examples of questions in the analysis level:

"Observe the shape of the Moon for 15 days and draw it in your notebook." (T3)

When the sample questions asked by the above teachers to the students are examined, it is seen that the questions are general knowledge level/simple, and they ask simple questions related to remembering and understanding.

CONCLUSION, DISCUSSION, and RECOMMENDATIONS

This study evaluated the questions asked by primary school teachers about the acquisition of place and way-finding from geography subjects according to the revised Bloom Taxonomy. The teachers prepared the questions. It has been determined that almost all of the questions asked by the teachers are at the level of remembering, understanding, and application (lower cognitive level) (See Table 3). It determined that it asked only one question at the analysis, evaluation, and creation level (high-level cognitive level), and this question was at the analysis level (See Table 3). This situation shows that the questions prepared by the teachers do not include the metacognitive level. Therefore, when the distribution of question generation among the achievements is examined according to the levels of the teachers in the cognitive process dimension of the taxonomy, it is seen that the questions they prepare are mainly at a low level. According to the revised Bloom Taxonomy, when the studies in the literature are examined, the questions in the lower steps are used at higher rates (Çepni, Ayvacı, & Keleş, 2001; Dindar & Demir, 2006; Erdoğan, 2017; Geçit & Yarar, 2010; Işık Mercan, 2019; Köğce & Baki). , 2009; Yıldız, 2015; Şanlı & Pınar, 2017). However, teaching aims to acquire skills that increase knowledge transfer. The effective transfer of learned information is related to the application, analysis, evaluation, and creation steps rather than the remembering and understanding steps of the cognitive process dimension (İlhan & Gülersoy, 2019). In today's information age, it is impossible to qualify students who can read and memorize, write or express this information when asked to be successful. Students who can establish a cause-effect relationship, interpret information, question what they read, and use the information they have acquired daily are considered successful (Arseven, Şimşek, & Güden, 2016).

According to the results of the research, it is seen that the questions asked by primary school teachers about the acquisition of place and way-finding measure the low-level cognitive process dimension, and questions about the high-level cognitive process dimension are not asked. However, the use of geographical information, which is one of the reasons for the existence of geography, in all kinds of social and economic activities in the planning and production stages (Sözcü & Aydınözü, 2019) is related to the levels of analysis, evaluation, and creation that enable high-level thinking. In addition, the findings obtained from the research reveal that teachers do not ask questions at the upper levels of taxonomy, and they are insufficient in asking high-level questions, which is the essential element in effective questioning. In studies similar to our research, it has been revealed that teachers mostly prefer simple questions at the level of "understanding" and "remembering" and ask questions that require low-level mental processes to a large extent (Akyol, Yıldırım, Ateş, & Çetinkaya, 2013; Koray, Altunçekiç & Yaman, 2005; Ayvacı & Türkdoğan, 2010; Can, 2006; Çolak & Demircioğlu, 2010; Erdoğan, 2017; Işık Mercan, 2019; Şanlı & Pınar, 2017). In the study conducted by Uymaz and Çalışkan (2019) on the questions asked by social studies teachers in exams, it is seen that the results of the study are similar to the results of this research, as the questions are generally at the lower level of the cognitive process dimension of the taxonomy. The questions corresponding to the upper level are very few. This situation can be interpreted as the fact that the teachers did not take the Revised Bloom Taxonomy into account while preparing the questions and did not have sufficient knowledge about measurement and evaluation. In addition, it can say that teachers ask low-level cognitive questions in terms of both question preparation and high-level thinking skills and their competence to activate these skills.

Based on the findings obtained as a result of the research, we can conduct research on why teachers ask questions corresponding to the lower-level steps of the Revised Bloom Taxonomy in exams. It can suggest that primary school teachers create more questions for high-level cognitive domains in teaching the functional subject of place and direction. The Ministry of National Education should prepare high-level question samples for teachers. In-service training can be given by experts on the subject so that teachers can create high-level questions.

Statements of publication ethics

I/We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

Kastamonu University Social and Human Sciences Research and Publication Ethics Committee Decision No. 3/35 and 12/10/2020

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Appendix 1. Revised Bloom Taxonomy (Krathwohl, 2002; Amer, 2006)

İnformation Dimension		Cognitive Process Dimension					
		Remember	Understand	Apply	Analyze	Analyze	Analyze
A. Olgusal Bilgi	**Aa.** Terminology knowledge **Bb.** Information about specific details and elements	Retrieve relevant information from long-term memory	Determining the meaning of instructional messages	Applying or using a learned principle in a different situation	Breaking down information and identifying how the pieces relate to each other and an overall structure or purpose	Making judgments based on criteria and standards	Combining elements to form a new, coherent whole or to make an original product
		*Recognition *Recall	*Turning *Sampling *Classification *Summarizing *Do not infer *To compare *Description	* Executive * Apply	*Differentiation **Organization Attribution	*Control *Criticism	*Creation *Planning *To produce

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| Araştırma Makalesi / Research Article |

The Place of Modal School Songs In Music Education

Makamsal Okul Şarkılarının Müzik Eğitimindeki Yeri

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Keywords

1. Modal school songs
2. Music education
3. Modals

Anahtar Kelimeler

1. Makamsal okul şarkıları
2. Müzik Eğitimi
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Abstract

Purpose: This study aims to investigate and evaluate the position of modal school songs used in singing activities in our schools, and in music education, in line with expert opinions. For this purpose, a questionnaire was applied to music teachers, choir conductors and academicians working in the field to investigate the teaching and learning situations of modal school songs in music lessons.

Materials and Methods: Before the implementation, the items in the questionnaire were tested by consulting expert opinion. Seventy-four experts were reached in the survey study, and their opinions were recorded. In the study, the song types in the song repertoire were explained separately according to their genres, and it was stated which of these genres belonged to the modal song type. A descriptive general survey method was used in the research. The content validity of each item in the questionnaire was analyzed with the Lawshe technique. The experts answered all the items in the questionnaire, considering the expressions corresponding to the numbers 1 to 5. In the findings and comment section, the solution to the research problems was analyzed and evaluated with statistical methods.

Findings: In the expert opinions on the teaching of modal songs, it was determined that the students could quickly learn the songs, they are catchy and are sung in a motivated way by the students, while it is determined that the modal school songs are included in the music curriculum adequately and contain the necessary qualifications in terms of education.

Highlights: In light of the results, based on the music curriculum's approach to maqam songs, the use of such melodies in educational music composing classes, in composing studies in the form of Turkish music, in maqam (hearing-speaking-writing) works, in state broadcasting organs such as radio and TV, and in cultural activities carried out by the Ministry of Culture, It has been suggested that the number of scientific studies on this subject should be increased and that modal song genre should gain a universal quality with these applications.

Öz

Çalışmanın Amacı: Bu çalışmada okullarımızda şarkı söyleme etkinliklerinde çeşitli kaynaklardan faydalanılarak kullanılan makamsal okul şarkılarının müzik eğitimindeki yeri uzman görüşleri doğrultusunda araştırılıp, değerlendirilmiştir. Bu amaç doğrultusunda makamsal okul şarkılarının müzik dersi içerisindeki öğretme – öğrenme durumlarının araştırılması için sahada çalışan müzik öğretmenlerine, koro şeflerine ve akademisyenlere bir anket uygulanmıştır.

Materyal ve Yöntem: Uygulama öncesinde ankette yer alan maddeler yine uzman görüşüne başvurularak sınanmıştır. Anket çalışmasında 74 uzmana ulaşılmış ve görüşleri kaydedilmiştir. Çalışma içerisinde şarkı dağarında yer alan şarkı türleri, türlerine göre ayrı ayrı açıklanmış, bu türler içerisinde hangilerinin makamsal şarkı türüne ait oldukları belirtilmiştir. Araştırmada betimsel genel tarama yöntemi kullanılmıştır. Ankette bulunan her bir maddenin kapsam geçerliliği Lawshe tekniği ile analiz edilmiştir. Ankette bulunan tüm maddeler 1 ile 5 arası rakamlara karşılık gelen ifadeler dikkate alınarak uzmanlar tarafından cevaplanmıştır. Bulgular ve yorum bölümünde araştırmaya yönelik problemlerin çözümü istatistiksel yöntemler ile analiz edilip değerlendirilmiştir

Bulgular: Makamsal şarkı öğretimine yönelik uzman görüşlerinde şarkıların öğrenciler tarafından kolayca öğrenilebildiği, akılda kalıcı olduğu ve öğrenciler tarafından motive bir şekilde söylenildiği gibi sonuçlara ulaşılırken, makamsal okul şarkılarını müzik müfredatında yeterli şekilde yer aldığı ve eğitim öğretim açısında gerekli yeterlilikleri barındırdığı belirlenmiştir.

Önemli Vurgular: Sonuçlar ışığında; müzik müfredatının makamsal şarkılarla ilgili yaklaşımından hareketle, bu tür ezgilerin eğitim müziği besteleme derslerinde, Türk müziği formunda yapılan besteleme çalışmalarında, makamsal (işitme-söyleme-yazma) çalışmalarında devletin radyo - tv gibi yayın organlarında ve kültür bakanlığı tarafından, bakanlıkça yapılan kültürel faaliyetlerde kullanılması, bu konuyla ilgili bilimsel araştırma sayısının artırılması ve bu uygulamalarla makamsal şarkı türlerinin evrensel bir nitelik kazanması gerektiği önerilerinde bulunulmuştur.

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INTRODUCTION

From the pre-school period to the secondary education period, music education has great importance in the development and educational life of the individual. While music education develops the individual in many ways, it also has an important task that provides the link between other courses and disciplines. Singing activities are the most critical activities that fulfill this task.

“Music education is a process of gaining a musical behavior, creating a musical behavior change, and developing a musical behavior. In this process, the individual's (child/teen, student's) musical life is taken as the basis, and a planned, regular and methodical path is followed in line with certain purposes. Certain goals are achieved in this way. Through music education, it is expected that the communication and interaction between the individual and his/her environment, especially the musical environment, will be healthier, more regular, more effective and more efficient” (Uçan, 2005, p.14).

Singing is the most preferred activity in education and training programs and most preferred by teachers. Along with the singing activity, the individual's musical abilities such as voice dominance, sense of rhythm, choir habit, and musical memory are developed, as well as supporting the acquisitions of many areas such as using his/her language, increasing his/her vocabulary, acquiring numerical and geographical gains, and socialization. According to Aktaş, some of the basic features that school songs should have and should bring to students are as follows.

Since the music lesson is a collective lesson, care should be taken to ensure that the school songs to be taught are collectively sung.

While selecting school songs, attention should be paid to the fact that the songs are broadcast by media organs such as radio and television, and the school songs in such broadcasts should be recorded on radio and television and listened to by students.

The lyrics of the selected school songs should be easy to understand and cute, and the lyrics should also be interesting.

The ages, abilities, and musical education levels of the group of students to whom the school song is taught should correspond to the school song learned.

The lyrics of school songs should be by the discipline, taste and psychology of the child and should also be didactic.

The melodies of school songs should have original artistic value.

School songs should also be instructive in terms of historical and national anthems that will be repeated throughout life.

Thanks to school songs, students should be able to show themselves and gain a sense of self-confidence.

In addition to these items, the following can be said;

Songs with solo parts should also be included in the repertoire of school songs taught in music lessons in primary schools.

The environmental factor should also be considered while teaching school songs.

Attention should be paid to the accompaniment of the school songs taught, and the level of school songs should not be lowered to be accompanied (Aktaş, 2008).

It consists of composing songs used in music education at various levels, songs brought to our music education from foreign genres, songs inspired by western music sound and harmony systems and transposed from Turkish folk music and classical music genres. Especially after the 1950s, songs in Turkish folk music and art music genres started to take place frequently in our repertoire. In the recent period, the songs that have been added to the song repertoire are the songs that were brought in by the leading educational music composers of the period.

After 1950, new ideas were brought to school music education, and attempts were made to take folk music as a basis for school music. As a result of these studies accelerated after 1960, the new school music education approach was adopted by many music educators. (Sager, 2004)

Our country's songs used in education are divided into four main groups.

Transposition Songs: These are songs with foreign tunes and Turkish lyrics. The melodies of the transposition songs are generally taken from the folk music and school music of some European societies.

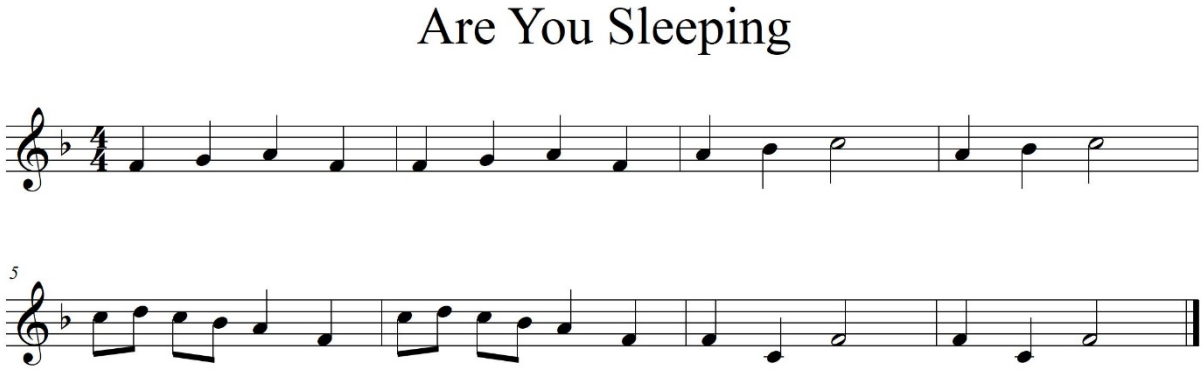

Figure 1. Example of Transposition School Song

When “Are you sleeping” When the song is examined, this song, which was produced in a foreign country, is included as a transfer song in the Turkish school song repertoire.

Emulation Songs

They are school songs created by Turkish School Music composers, taking their source from the music of other societies. These are songs made by Turkish composers in the major and minor scales and measures of western music, emulating Western societies' aesthetic understanding and taste, but which are foreign to the Turkish people with their structure and essence.

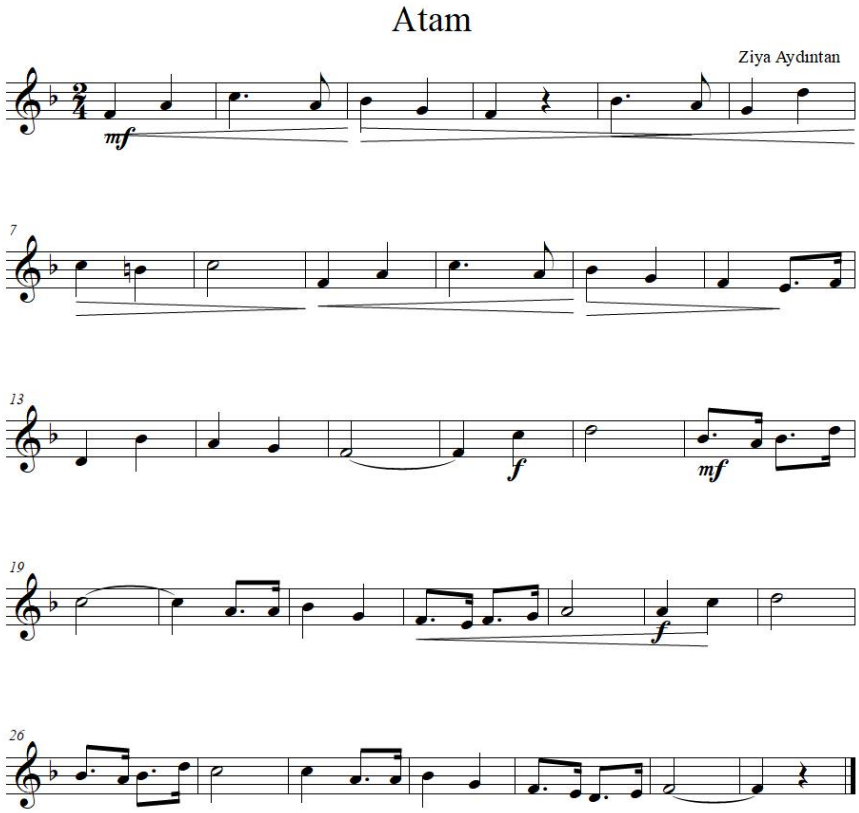

Figure 2. Example of emulation school song

Ziya Aydıntan's song “Atam” (anthem) is an imitation song composed following western music form and harmony rules and is frequently included in our music books.

Anonymous Songs (nursery rhymes, rhymes, lullabies, folk songs)

When anonymous songs are mentioned, it is necessary to give information about the elements of our culture, such as nursery rhymes and rhymes, lullabies and folk songs. Nursery rhymes and rhymes are products of children's folklore. Children create them according to the needs of children's life (especially play life). Lullabies are also folklore products. Mothers often create lullabies; They are sung by women such as mothers, grandmothers, older sisters and aunts to put the child to sleep. It is clear what is meant by the phrase folk songs. Our people have created these folk songs over the centuries, kept alive by filtering their taste and time, with their scales - measures - structure - essence - word - sensibility...

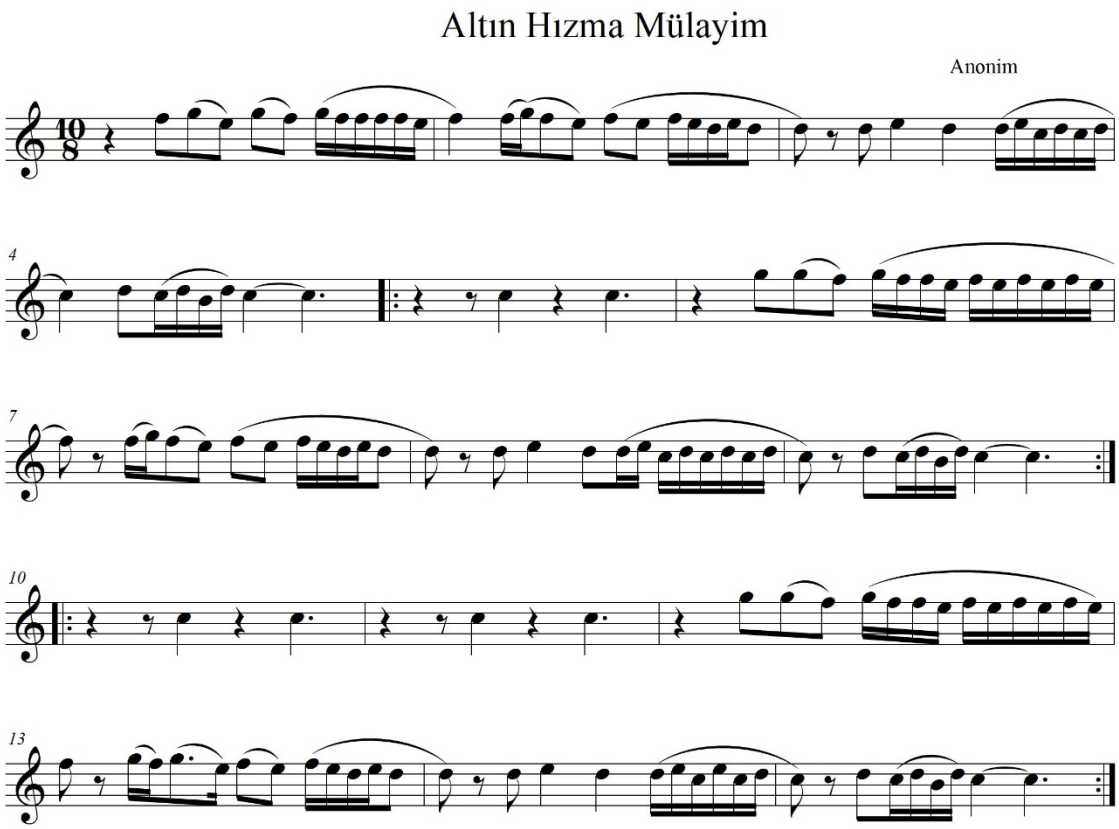

Figure 3. Example of Anonymous School Song

When examining the school song named "Altın Hızma Mülayim" is a school song whose composer and lyricist are unknown, written in the çargah modal, in the 10/8 beat, and suitable for the form and theory of Turkish music.

Turkish School Songs

They are school songs created by Turkish composers, which take their source from our folk music. These are original creations made in Turkish music scales and measures, suitable for the taste of our people, developing it, taking its structure and essence from our folk music (Sun and Seyrek, 1993).

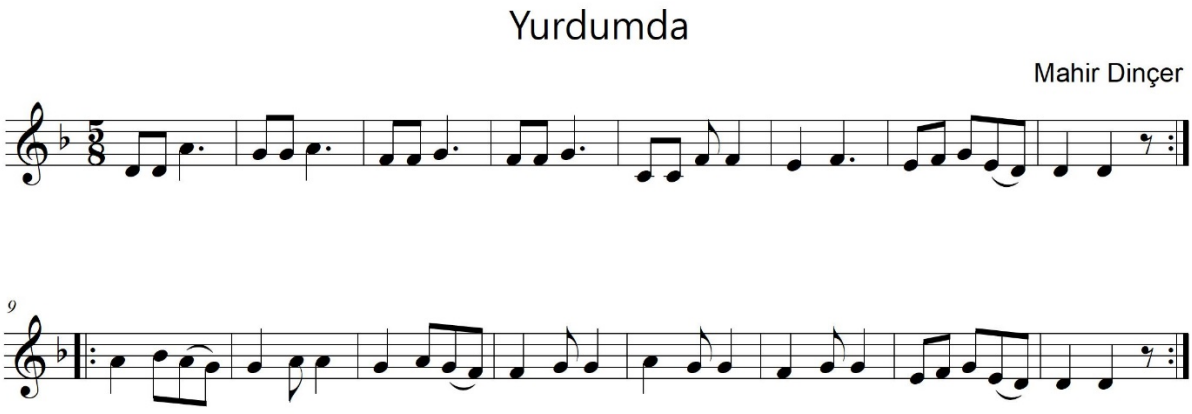

Figure 4. Example of Turkish School Song

When the Turkish school song above is examined, it is a school song written according to the form and characteristics of Turkish music. Its modal is the Hüseyni modal, and its mode (beat) is 5/8.

In short, when we examine the school song types of the four groups, we see that the transposition and emulation song types contain western music form and harmony features. When we examine the anonymous and Turkish music schools, we see that Turkish music has form and theory features.

From the period from the Republic's first years to the present day, there are periodic differences in the genres of the songs in the song repertoire.

Until the 1950s, Turan Sağer listed names such as “Musa Süreyya, A. Muhtar, Zeki Üngör, Veli Kanık, Hulisi Ökdem, Halil Bedii Management, Ferit Hilmi Atrek, Bedri Akalın” among the composers of educational songs. (Sager, 2002, p.2). In addition to the composition works of these composers, foreign transposition songs have been added to our repertoire. From this period until today, Turkish music songs have been added to our song repertoire by increasing year by year.

There are two main groups: the songs composed according to the transposition and western music forms in the school song repertoire and the songs according to the modal Turkish music forms. Since there is no previous study on the scientific data between these two different types, this subject arouses scientific interest. The opinions of music teachers, academicians and choir conductors, who are the best observers of these two genres taught in singing activities in schools, form the basis of this study.

In this study, field experts' opinions and impressions about the situation of modal and tonal school songs in the learning and teaching process are consulted.

Problem Status

There are both modal and tonal songs in our song repertoire. The process of these two song types in learning and teaching has yet to be scientifically known. For this reason, expert opinions between the two types are essential. The problem sentence of this research is “What does the position of modal school songs look like in music education?”

Sub Problems

What are the expert opinions on modal school songs?

What are the expert opinions on the position of modal school songs in the music lesson curriculum?

Aim of the research

This research aims to determine the expert opinions on the position of modal school songs in music education.

Importance of Research

With this research, the development of music education needs to determine the positive and negative aspects of using and applying modal school songs in music lessons. Sound scientific studies on the species are essential in forming an idea for future studies in this field.

METHOD/MATERIALS

Data Collection

At the data collection stage, expert opinions on the position of modal school songs in music education were determined using a 5-point Likert questionnaire and entered into the data set. The suitability of the questionnaire for use was examined by faculty members and music teachers working in the Ministry of National Education, and it was determined to be suitable for its purpose. The experts' opinions determined the content validity rate of each item in the survey, and a survey item with a low content validity rate was removed from the survey. The survey item was determined as 14.

Although the most common technique used for content validity is the Lawshe technique, other techniques have also been developed. Of these, Davis (1992) grades expert opinions as (a) "Appropriate," (b) "The item should be slightly revised," (c) "The item should be reviewed seriously," and (d) "The item is not appropriate." In this technique, the number of experts who chose options (a) and (b) is divided by the total number of experts, and the "scope validity index" for the item is obtained, and a value of 0.80 is accepted as a criterion instead of comparing this value with a statistical criterion (Yurdagül, 2005).

Analysis of Data

A 5-point Likert scale was used to determine the scores given to the items in the questionnaire. The opinions of the experts (n=73) were determined by taking the median value (median) of the scores given by the experts (n=73) between 1 and 5 for each of the items in the questionnaire, which was created by taking into account the opinions of the experts. The expressions used in response to the numbers between 1 and 5 are shown in Table 1.

Table 1. Numerical equivalents of expressions

Expert opinions	Numerical equivalent
Strongly disagree	1
Disagree	2
Undecided	3
Agree	4
Strongly agree	5

FINDINGS AND COMMENTS

Findings and Comments Regarding the First Sub-Problem

The first sub-problem of the study, "What are the expert opinions on modal school songs?" Findings and comments on the question are given below.

In order to obtain data on the first sub-problem of the research, the experts in the survey;

I can teach modal songs more easily than tonal songs.

Students enjoy singing modal songs.

Students can memorize modal songs more easily.

Students are more prone to Turkish Music rhythm features.

Modal school songs meet the musical needs of students.

Modal school songs support students to use their voices effectively.

The modal school songs are within the limits of the students' voices.

The modal school songs are suitable for all grade levels.

Modal school songs can be taught within 1 lesson hour.

Table 2 was formed by taking the median of the scores given to the items.

Table 2. Median values of items related to the first sub-problems

	Items	Median Value
1	I can teach modal songs more easily than tonal songs.	4
2	Students enjoy singing modal songs.	4
3	Students can memorize modal songs more easily.	5
4	Students are more prone to Turkish Music rhythm (5/8, 7/8, 8/8 Etc.) features.	3
5	Modal school songs meet the musical needs of students.	4
6	Modal school songs support students to use their voices effectively.	4
7	The modal school songs are within the limits of the students' voices.	4
8	The modal school songs are suitable for all grade levels.	4
9	Modal school songs can be taught within 1 lesson hour.	5

Experts (n=74) said in the survey “I can teach modal songs more easily.” It is seen that the median value (median) of the scores given to the item is 4 (agree).

Opinions of experts on the relevant item; Strongly Disagree: 8, Disagree: 11, Undecided: 13, Agree: 24, Strongly Agree: 18.

The data is graphically shown below.

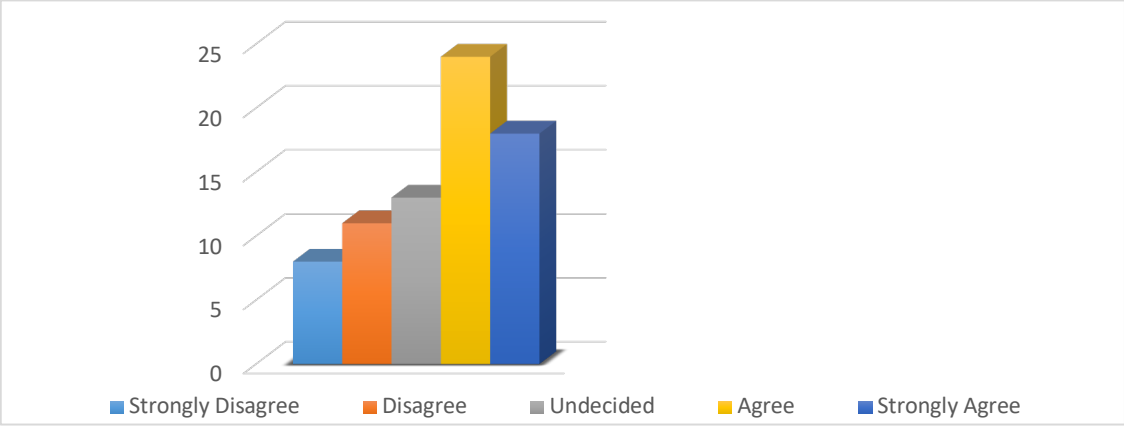

Figure 5. Distribution of experts' opinions on item "I can teach modal songs more easily."

Experts (n=74) stated that “Students enjoy singing modal songs.” It is seen that the median value (median) of the scores given to the item is 4 (agree).

Opinions of experts on the relevant item; Strongly Disagree: 7, Disagree: 6, Undecided: 9, Agree: 30, Strongly Agree: 22.

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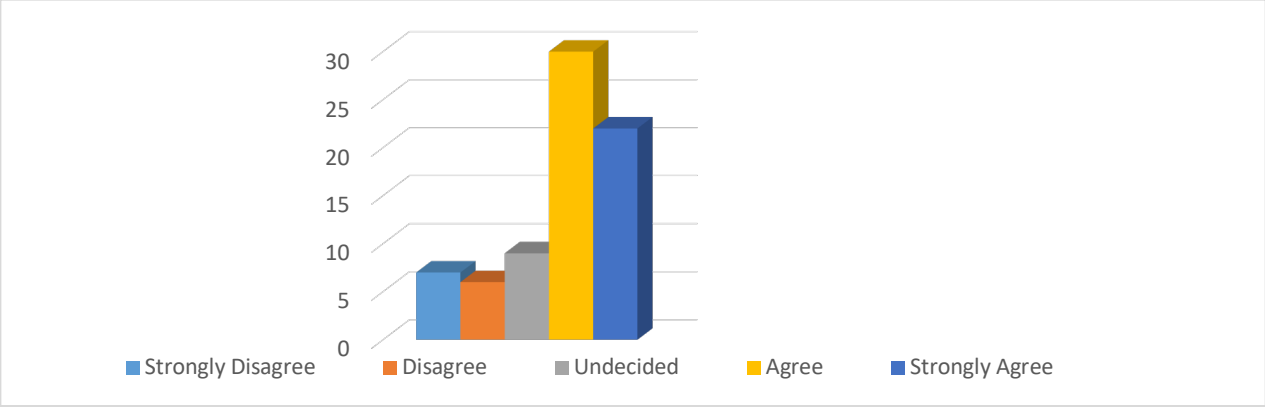

Figure 6. The distribution of opinions of the experts on the item “Students enjoy singing modal songs.” in the questionnaire

It is seen that the median value (median) of the scores given by the experts (n=74) to the item “Students can memorize modal songs more easily.” in the questionnaire is 5 (strongly agree).

Opinions of experts on the relevant item; Strongly Disagree: 1, Disagree: 2, Undecided: 4, Agree: 25, Strongly Agree: 42.

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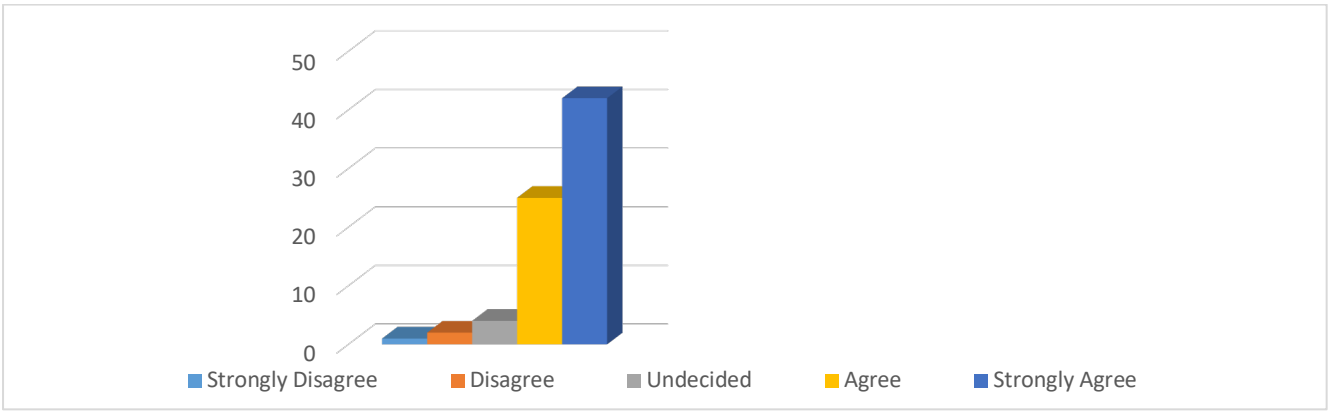

Figure 7. The distribution of opinions of the experts on the item “Students can memorize modal songs more easily.” in the questionnaire

“Students are more prone to Turkish Music rhythm (5/8, 7/8, 8/8 Etc.) features.” It is seen that the median value (median) of the scores given to the item is 3 (Undecided).

Opinions of experts on the relevant item; Strongly Disagree: 5, Disagree: 20, Undecided: 24, Agree: 17, Strongly Agree: 8.

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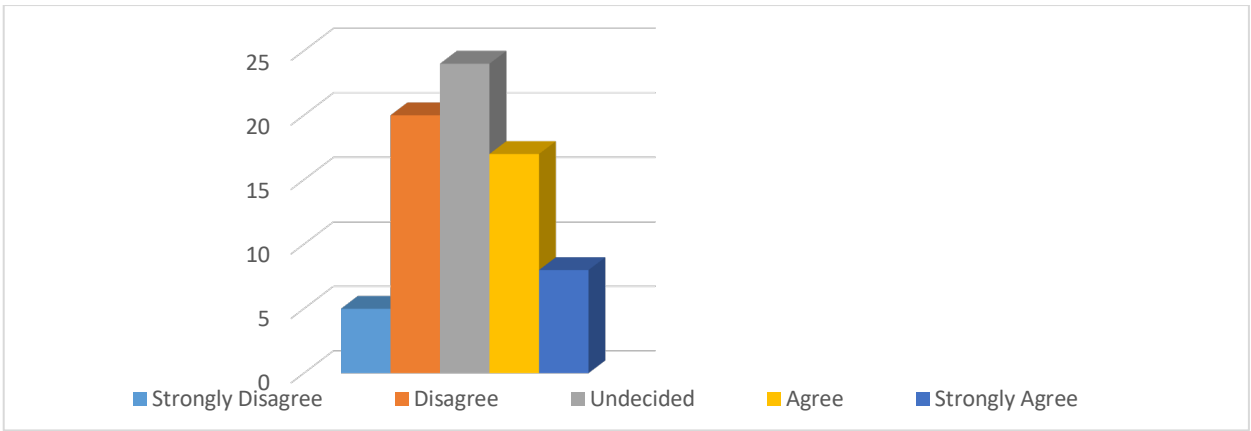

Figure 8. The distribution of opinions of the experts on the item “Students are more prone to Turkish Music rhythm (5/8, 7/8, 8/8 Etc) features.” in the questionnaire

It is seen that the median value (median) of the scores given by the experts (n=74) to the item “Modal school songs meet the musical needs of students.” in the questionnaire is 4 (agree).

Opinions of experts on the relevant item; Strongly Disagree: 8, Disagree: 11, Undecided: 13, Agree: 26, Strongly Agree: 16.

The data is shown in figure 9.

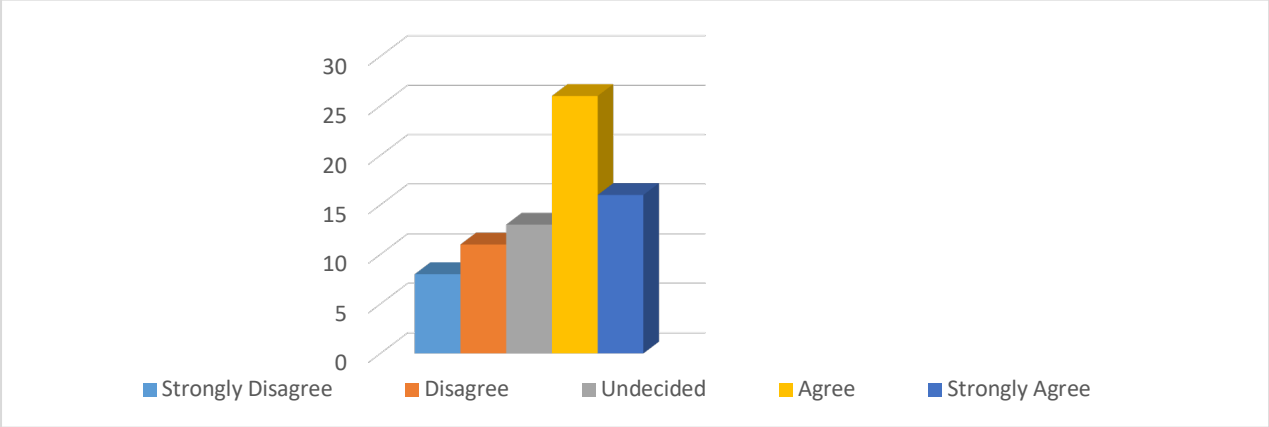

Figure 9. The distribution of opinions of the experts on the item “Modal school songs meet the musical needs of students.” in the questionnaire

It is seen that the median value (median) of the scores given by the experts (n=74) to the item “Modal school songs support students to use their voices effectively.” in the questionnaire is 4 (agree).

Opinions of experts on the relevant item; Strongly Disagree: 11, Disagree: 6, Undecided: 17, Agree: 24, Strongly Agree: 16.

The data is graphically shown below.

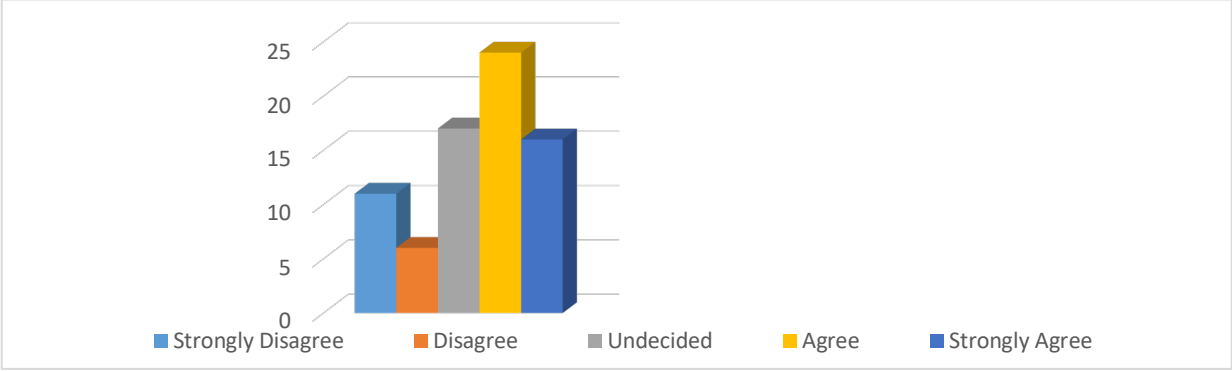

Figure 10. The distribution of opinions of the experts on the item “Modal school songs support students to use their voices effectively.” in the questionnaire

Experts (n=74) included “The modal school songs are within the limits of the students' voices.” It is seen that the median value (median) of the scores given to the item is 4 (agree).

Opinions of experts on the relevant item; Strongly Disagree: 16, Disagree: 8, Undecided: 11, Agree: 18, Strongly Agree: 21.

The data is shown in figure 10.

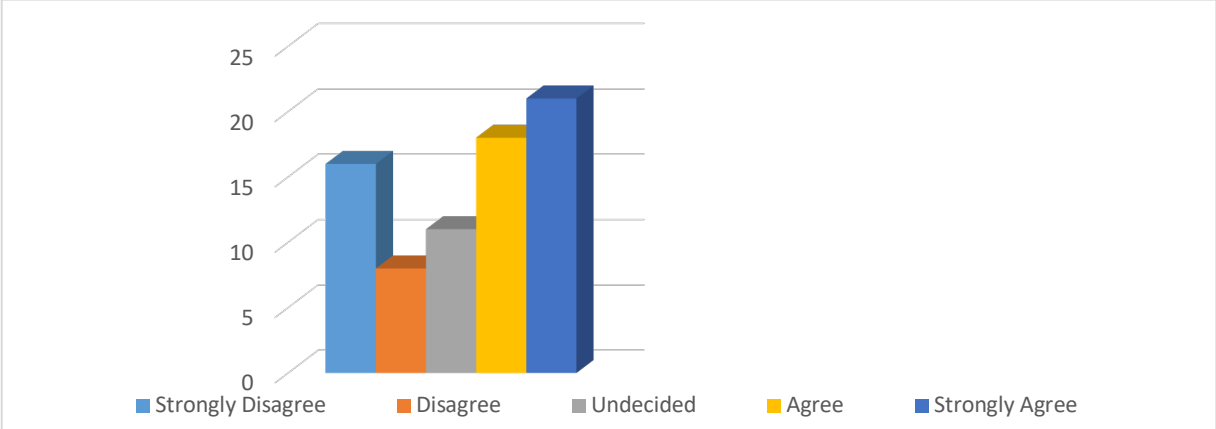

Figure 11. Distribution of experts' opinions on the item " The modal school songs are within the limits of the students' voices." in the questionnaire

It is seen that the median value (median) of the scores given by the experts (n=74) to the item “The modal school songs are suitable for all grade levels.” in the questionnaire is 4 (agree).

Opinions of experts on the relevant item; Strongly Disagree: 5, Disagree: 16, Undecided: 14, Agree: 19, Strongly Agree: 20.

The data is graphically shown below.

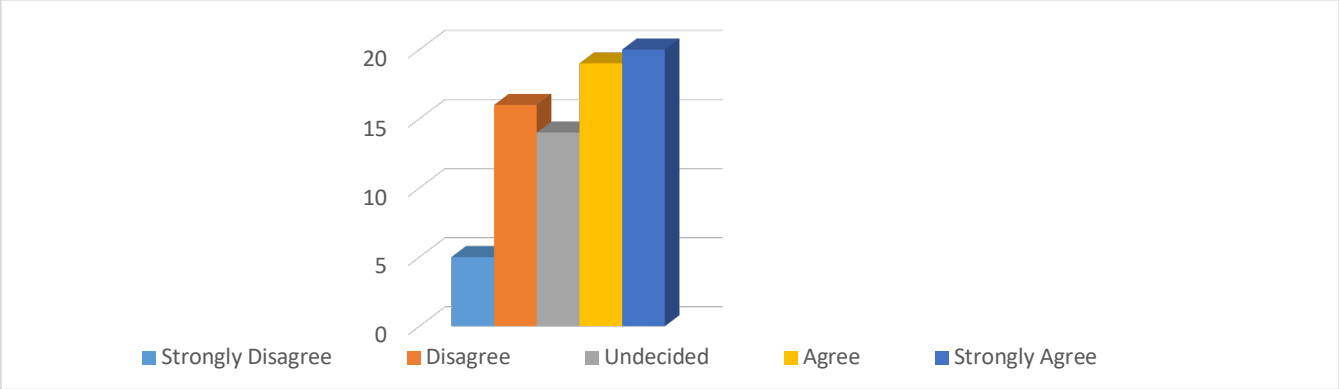

Figure 12. The distribution of opinions of the experts on the item “The modal school songs are suitable for all grade levels.” in the questionnaire

It is seen that the median value (median) of the scores given by the experts (n=74) to the item “Modal school songs can be taught within 1 lesson hour.” in the questionnaire is 5 (I totally agree).

Opinions of experts on the relevant item; Strongly Disagree: 6, Disagree: 5, Undecided: 8, Agree: 24, Strongly Agree: 31.

The data is shown in figure 13.

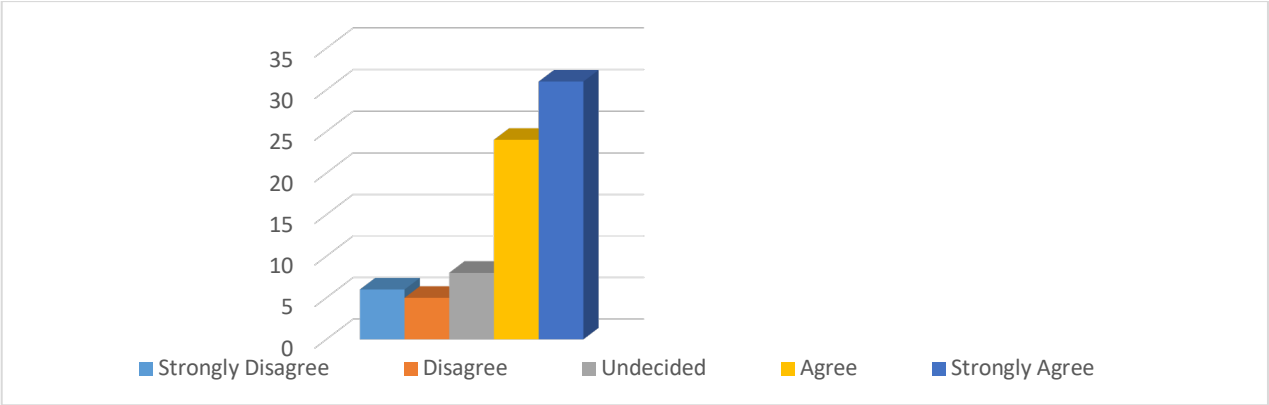

Figure 13. The distribution of opinions of the experts on the item “Modal school songs can be taught within 1 lesson hour.” in the questionnaire

From the data obtained from Table 2 and the graphics above, it is seen that modal school songs can be taught more easily than tonal songs, students enjoy singing modal songs, and they can memorize modal songs more easily. In addition, these songs are suitable for the sound limits of the students, the songs can be applied at all grade levels in the schools, and the modal school songs can be taught in the classroom within 1 class hour. However, it is thought that Turkish Music rhythms do not bring any convenience or difficulty in teaching the song and that the modal school songs meet the musical needs of the students since the experts in the survey gave an undecided opinion on the item related to Turkish Music rhythms (5/8, 7/8, 8/8 Etc.).

Findings and Comments Regarding the Second Sub-Problem

The second sub-problem of the research,“What are the expert opinions on the position of modal school songs in the music lesson curriculum? Findings and comments on the question are listed below. In order to obtain data on the third sub-problem of the research, the experts in the survey;

“Modal songs are sufficiently included in the music lesson curriculum.”

“The modal songs in the curriculum have educational qualifications.” Table 3 was formed by taking the median value (median) of the scores given to the item.

Table 3. Median values of items related to the second sub-problems

	Items	Median Value
1	Modal songs are given enough space in the music lesson curriculum.	5
2	The modal songs in the curriculum have sufficiency in terms of education.	4

It is seen that the median value (median) of the scores given by the experts (n=74) to the item "Modal songs are given enough space in the music lesson curriculum." in the questionnaire is 5 (Strongly agree).

Opinions of experts on the relevant item; Strongly Disagree: 9, Disagree: 4, Undecided: 9, Agree: 11, Strongly Agree: 41.

The data is shown in figure 14.

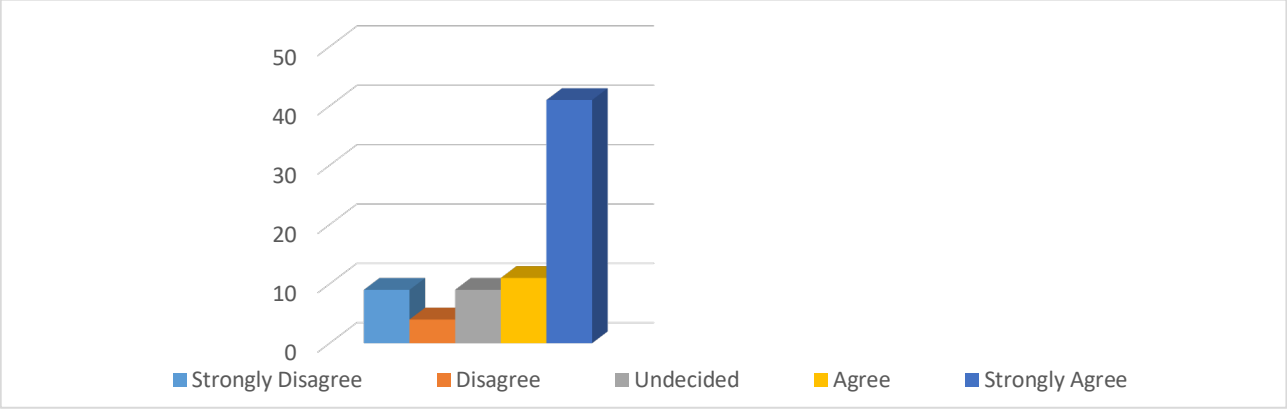

Figure 14. The distribution of opinions of the experts on the item "Modal songs are given enough space in the music lesson curriculum." in the questionnaire

It is seen that the median value (median) of the scores given by the experts (n=74) to the item "The modal songs in the curriculum have sufficiency in terms of education." in the questionnaire is 4 (agree).

Opinions of experts on the relevant item; Strongly Disagree: 13, Disagree: 14, Undecided: 7, Agree: 30, Strongly Agree: 9.

The data is graphically shown below.

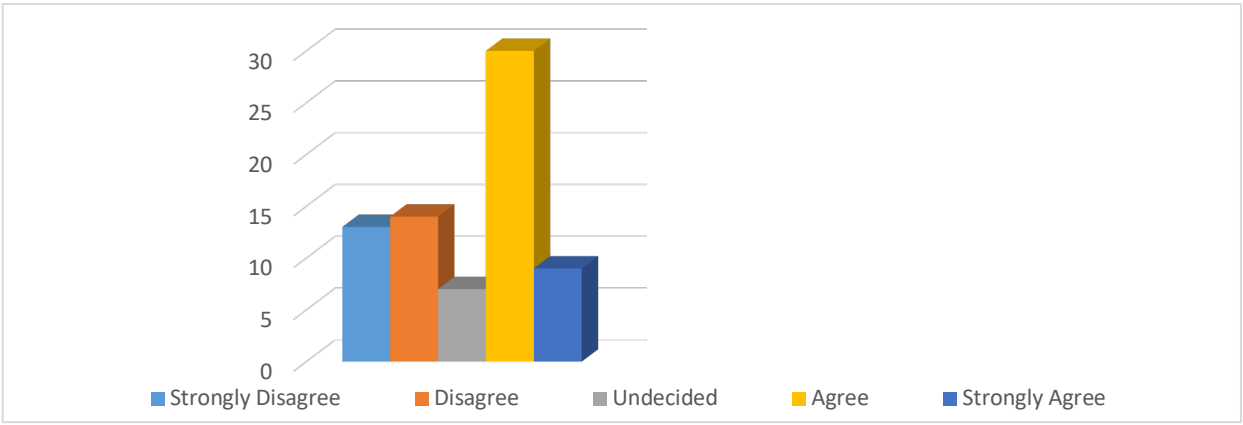

Figure 15. The distribution of opinions of the experts on the item "The modal songs in the curriculum have sufficiency in terms of education." in the questionnaire

When the data obtained from Table 3 and the graphics, the modal school songs are sufficiently included in the music lesson curriculum, and the modal school songs in the curriculum are sufficient in education.

CONCLUSION AND DISCUSSION

School songs, undoubtedly the most critical element and material of music education, can show differences due to the features they contain. One of the most important of these differences is the modal school songs. Too many modal school songs have been voiced for hundreds of years, handed down from generation to generation, and composed in accordance with this form in our recent history.

As a result of this study which was carried out to find answers to questions such as how the modal school songs are perceived/used by the lesson teachers in the music education process;

- The modal school songs are loved and sung by the students,
- Students learn most modal school songs more easily than tonal songs,
- The modal school songs are catchy,
- The students did not have difficulty in learning Turkish rhythm features despite being more complex than tonal song rhythms,
- Modal school songs both develop Turkish traditions and customs and teach the students,
- There are enough modal school songs in their music, books and publications,

- The school songs in the curriculum are of sufficient quality and equipment in terms of educational principles,
- The language development of the students is affected positively by the modal school songs,
- The modal school songs meet the musical needs of the students,
- The modal school songs will improve the voice characteristics of the students and support them in using their voices effectively,
- It has been concluded that modal school songs are suitable for all classes and levels.

RECOMMENDATIONS

In line with the results of the research, the following recommendations are presented:

- The modal school songs should be included in the following curriculum and book studies in a balanced as tonal songs,
- The Ministry of National Education's planning and activities to encourage school music composers to compose modal school songs,
- TRT, Ministry of Culture Etc. Giving more place in public institutions for the promotion of modal school songs,
- Supporting with solfege exercises apart from the modal school songs,
- Music teachers to be more encouraging towards modal school songs,
- Particularly in the first years of education, more place to be given to modal school songs, as they can be quickly learned and memorized,
- Since the teacher is more encouraging, accompanying the songs with the instrument,
- Supporting the student with extracurricular exercises and studies as it develops the student in many ways,
- Families reinforce their children in this regard and support them in this area,
- Organizing parades, concerts, Etc. to support school songs in modal schools,
- Academicians and researchers should focus on more detailed and wide-ranging studies on modal school songs,

It is necessary to carry out studies to include our country's modal school songs in the curricula and music books of other countries, as is the case with the transposed songs of other countries cultures, which are among the tonal songs. It is recommended that modal school songs, which are a part of Turkish culture, reach the level of similar examples in the world and introduce them.

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Statements of publication ethics

I/We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

This study does not include an ethics committee report, as it is derived from "Instead modal expert opinions toward training school songs music in education" published in 2015.

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| Research Article / Araştırma Makalesi |

Analysis of the Relationship Between Transformational Leadership and Organizational Commitment According to Teacher Perceptions

Öğretmen Algılarına Göre Dönüşümcü Liderlik ile Örgütsel Adanmışlık Arasındaki İlişkinin Analizi[1]

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Keywords

1. Transformational leadership
2. Organizational commitment
3. Mixed method

Anahtar Kelimeler

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3. Karma yöntem

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Abstract

Purpose: This research aims to analyze the relationship between transformational leadership and organizational commitment according to teachers' perceptions.

Design/Methodology/Approach: This research was designed as descriptive and relational research and was conducted using the mixed method. The research population comprises 1757 middle and high school teachers working in the Kızıltepe district of Mardin province during the 2020-2021 academic year. The sample consists of 338 teachers.

Findings: As a result of the research, it was revealed that school managers exhibited a very high level of transformational leadership characteristics according to teachers' opinions. It was found that the highest mean among the sub-dimensions belonged to the idealized influence dimension. While there was no significant difference between the independent variables, such as gender, age, level of employment, education level, and the time worked with the manager, a significant difference was found between the transformational leadership and the seniority variable. When the organizational commitment levels of the teachers were examined, it was found that their commitment was at a high level. Teachers stated that they were most emotionally committed to their organizations. There was no significant difference between teachers' organizational commitment and independent variables. When the relationship between transformational leadership and organizational commitment was examined, medium-level and positive relationships were found at the general and sub-dimensions. Data obtained from interviews with teachers also support these results. In addition, the findings obtained from the interviews with the teachers within the scope of the qualitative part of the study support the findings obtained in the quantitative part.

Highlights: As a result of the findings obtained from this research and the literature review, it can be concluded that transformational leadership positively affects teachers' organizational commitment. With the school manager's transformational leadership behaviors, the teachers' organizational commitment levels can be increased.

Öz

Çalışmanın amacı: Bu araştırmanın amacı öğretmen algılarına göre dönüşümcü liderlik ile örgütsel adanmışlık arasındaki ilişkinin analizini yapmaktır.

Materyal ve Yöntem: Bu araştırma, betimsel ve ilişkisel bir araştırma olarak tasarlanmış olup karma yöntem kullanılarak yapılmıştır. Araştırmanın evrenini 2020-2021 eğitim-öğretim yılı süresince Mardin ili Kızıltepe ilçesindeki resmi okullarda görevli olan 1757 ortaokul ve lise öğretmeni oluşturmaktadır. Örneklem ise 338 öğretmenden oluşmaktadır.

Bulgular: Araştırma sonucunda, öğretmen görüşlerine göre okul yöneticilerinin çok yüksek düzeyde dönüşümcü liderlik özellikleri sergiledikleri bulgularına ulaşılmıştır. Alt boyutlar arasında en yüksek aritmetik ortalamanın ideal etki boyutuna ait olduğu bulgulanmıştır. Bağımsız değişkenlerden cinsiyet, yaş, çalışılan kademe, eğitim düzeyi ve müdür ile çalışılan süre arasında anlamlı fark bulunmazken, dönüşümcü liderlik ile kıdem değişkeni arasında anlamlı fark bulunmuştur. Öğretmenlerin örgütsel adanmışlık düzeyleri incelendiğinde, adanmışlıklarının yüksek düzeyde olduğu bulgusuna ulaşılmıştır. Öğretmenler en çok duygusal olarak örgütlerine adanmış olduklarını belirtmişlerdir. Öğretmenlerin örgütsel adanmışlıkları ve bağımsız değişkenler arasında anlamlı fark bulunmamıştır. Dönüşümcü liderlik ile örgütsel adanmışlık arasındaki ilişki incelendiğinde, alt boyutlar ve genel düzeyde olumlu yönde orta düzey ilişkiler tespit edilmiştir. Öğretmenlerle yapılan görüşmelerden elde edilen veriler de bu sonuçları desteklemektedir. Ayrıca, araştırmanın nitel kısmı kapsamında öğretmenlerle yapılan görüşmelerden elde edilen bulgular, araştırmanın nicel kısmında elde edilen bulguları desteklemektedir.

Önemli Vurgular: Bu araştırmadan ve yapılan literatür taraması sonucu ulaşılan araştırmalardan elde edilen bulgular sonucunda, dönüşümcü liderliğin öğretmenlerin örgütsel adanmışlıklarına olumlu yönde etki ettiği sonucuna ulaşılabilir. Okul müdürünün sergileyeceği dönüşümcü liderlik davranışları ile öğretmenlerin örgütsel adanmışlık seviyeleri yükselebilir.

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INTRODUCTION

With the increase in production activities, production process management has gained importance in producing more qualified products. Çelik and Şimşek (2013) define management as the process of making and implementing decisions that will allow the effective use of human resources, material resources and time to achieve specific goals. In addition, management can also be defined as getting a group to work and providing cooperation and coordination among employees. In this context, many management theories have been developed, and the roles of employees and managers have been defined according to the perspectives of these theories. With the changing perception of management over time, the roles of managers and employees have also changed.

With the adoption of the modern management approach, new leadership theories emerge. Each theory has put forward a leader model according to its point of view. Developments in management have also shown their effect in schools where future generations are raised. Aslanargun and Bozkurt (2012) state that educational organizations are under the influence of transformation in this century, and the role of the leader has gained more importance. Geylani (2013) states that managers are the primary element in realizing the school's goals.

Managers may encounter various problems while ensuring that the school achieves its goals. The primary source of the problems can be the elements in the school and outside the school. These problems reveal that there is a need for some changes in the structure and management approach of schools and transformational leaders who will provide these changes.

The realization of the school goals is closely related to the efforts of the teachers in this regard. Teachers must have a high commitment to the institution they work for to achieve these goals. Celep (1998) states that the level of teachers' organizational commitment depends on the interaction between teachers, teacher-student communication, the quality of work and the way teachers perceive their profession. Joo, Yoon, and Jeung (2012) concluded that transformational leadership contributes positively to employees' organizational commitment. On the other hand, they emphasized that leaders can increase their employees' organizational commitment by putting forward a vision, supporting group goals and providing intellectual encouragement.

Transformational Leadership

Although James MacGregor Burns (1978) brought the concept of transformational leadership to management for the first time, it also inspired Bernard Bass, who contributed to this field (Bass & Riggio, 2010). Bass (2009) states that transformational leadership is a more appropriate leadership model for today's complex organizations, where personnel not only seek an inspiring leader but also expect a leader who will guide, challenge and empower them. According to Eraslan (2011), the reason for the existence of transformational leaders is change, and they define themselves as representatives of change. Çelik (2007) mentioned that organizations must constantly change, and transformational leaders can most adapt to the speed of this change. According to Elhawi (2019), one of the goals of transformational leadership is to clearly explain to the followers the organization's vision, the personnel's duties, and the reasons for which the decisions were made. Research studies state that transformational leadership is positively connected to subordinates' attitudes towards work, job performance, creativity, well-being, financial performance, and the leader's strengthening of influence (Barling, 2000).

Transformational leaders exhibit certain behaviors that enable them to be successful. First, they create a vision and enable their followers to communicate with that vision. Afterward, they try to convince their followers of this vision and increase their loyalty. To achieve this aim, they respect their followers, deal with their problems, communicate well and involve them in the decision process. Finally, they create a robust value system and realize organizational identification (Çelik, 2007).

Transformational leadership has four important sub-dimensions. In the idealized influence sub-dimension, the leader's behavior is at a level that will win the trust and respect of the followers, and as a result, the followers want to be like the leader. In addition, followers trust, emulate, and respect these leaders and think they have extraordinary abilities (Diaz-Saenz, 2011). The inspirational motivation sub-dimension includes behaviors that increase motivation and commitment to set a shared vision and achieve goals. Bass B. and Bass R. (2009) state that the transformational leader awakens the team spirit and keeps enthusiasm alive, helping the followers to dream of a vision while simultaneously enabling them to show commitment to the shared vision and goal. The intellectual stimulation sub-dimension includes the behaviors adopted by the leader to reveal the innovative and creative aspects of his followers. Bass B. and Bass R. (2009) argue that leaders enable followers to think innovatively and creatively by helping them draw new frames to problems, question assumptions, and look at old situations from new perspectives. In the individual consideration sub-dimension, transformational leaders pay attention to each follower's development and meet their needs. Hoy and Miskel (2015) state that leaders who care about individuals listen actively and effectively.

Like all institutions, schools also need qualified managers. The leadership style of school managers not only affects the satisfaction and motivation of teachers but also has an essential effect on the success and discipline of students. Buluç (2010)

stated that leadership styles affect organizational performance and that transformational leadership is more effective than other leadership styles.

Organizational Commitment

Commitment; beyond the behaviors that the organization expects from its employees, it is defined as the integration of the individual with the organizational goals and objectives and displaying attitudes and behaviors towards this goal by taking on other roles. Whyte first discussed organizational commitment in 1956 and was later developed by many researchers (Bozdemir & Yolcu, 2014). Celep (1998) defines organizational commitment as the employees adopting the goals and values of the organization they work for, doing their best to achieve them, and creating a tendency to stay in the organization.

Teachers' commitment to their schools, professions and students positively affects the effectiveness of the school. Teachers with low levels of commitment can be a negative factor in the achievement of the school's goals and the development of students. Increasing the factors that contribute to teacher commitment in schools and changing the factors that cause teacher commitment to be negative can increase the success of schools (Altunay, 2017).

Allen and Meyer analyzed organizational commitment as emotional commitment, continuance commitment and normative commitment (Sığrı, 2007). Firstly, emotional commitment means the emotional integration of the staff with the organization and their work in the organization. Secondly, continuance commitment refers to the staff's commitment to the organization in return for a reward. The more rewards are given, the greater the organization's commitment. Thirdly, normative commitment means that the person considers staying in the organization a responsibility. In other words, personnel with high normative dependency think they must stay in the organization.

The organizational commitment level of teachers may vary depending on the interaction between teachers at school, the communication between teacher and student, the quality of work and the degree of perception of teachers' profession (Celep, Doyuran, & Sarıdede, 2004). Employees with low organizational commitment are not firmly committed to the organization. A low level of commitment results in a decrease in the employee's success at work and the organization's efficiency. The medium level of commitment is where the person does not fully identify with the organization, and the level of commitment is not high. Employees with a high level of commitment show positive behaviors such as establishing strong ties with the organization, adopting and supporting the shared vision, and being in harmony with their colleagues.

Teachers' organizational commitment must be high for schools to achieve their goals. Some factors affect organizational commitment. Organizational commitment enables teachers to adopt their profession and the institution they work for more and to increase their job performance. Yavan (2016) argued that commitment positively affects fatigue, absenteeism, burnout, and depression.

Considering this situation, one of the elements necessary to progress in the educational field is teachers' organizational commitment. There are studies in the literature that have stated that high organizational commitment has a positive effect on job performance (Balyer, 2015 Tentama, 2016). Many factors affect teachers' organizational commitment (Ogunnaike, Oyewumni& Famuwagun, 2016; Hulpia & Devos, 2010; Bakan, Büyükbeşe & Erşahan, 2011 and Taştan, 2014). It can be thought that one of them is the leadership style adopted by the manager.

Transformational leaders encourage their employees to reach beyond the minimum institutional requirements standard based on leadership attitudes and behaviors such as inspiring their employees, raising their interest and meeting specific development needs (Bass, Avolio, Jung & Berson, 2003). Based on this statement, transformational leader behaviors can increase the employees' organizational commitment.

METHOD/MATERIALS

Research Design

This research was conducted using a mixed method. A mixed method is a research approach used in health, social and behavioral sciences. The researcher collects quantitative and qualitative data and concludes by integrating these data (Creswell & Sözbilir, 2017). In this study, the triangulation design was used. The triangulation design is a mixed-method design.

Moreover, quantitative and qualitative data are collected simultaneously, checking whether the two data types support each other (Baki & Gökçek, 2012). While the quantitative data in the research were obtained with descriptive and relational techniques, the qualitative data were obtained with the phenomenology pattern. Phenomenology is one of the qualitative research designs in which participants focus on their own experiences, express their ideas, and examine the relationship between participants' experiences and concepts (Yılmaz, Timur B., & Timur S., 2017). A scale was used to collect data in the quantitative dimension of the research, and a semi-structured interview form was used in the qualitative dimension.

The Sample of Research

The universe of the research consists of 1757 teachers working in official middle schools and high schools in the district of Kızıltepe in Mardin province in the 2020-2021 academic year. The sample consists of 338 teachers reached by the easily accessible sampling method. Convenience sampling is one of the non-random sampling methods. Randomness defines that all units have an equal chance of being selected in the sample selection (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2018). The study group was formed by using the maximum diversity method in the collection of qualitative data. The maximum variation method belongs to purposive sampling, one of the non-random sampling methods. The purpose of this method is to keep the diversity of individuals who may be a side to the problem at the highest level (Büyüköztürk, et al., 2018).

Table 1. Distribution of Demographic Characteristics of Teachers Participating in the Research

Demographic Distribution of Quantitative Data			
Variables		N	%
Gender	Female	135	39,9
	Male	203	60,1
Age	21-30	98	29
	31-40	168	49,7
	41-50	69	20,4
	51 and above	3	0,9
Teaching Seniority	1-5	134	39,7
	6-10	93	27,5
	11-15	45	13,3
	16-20	42	12,4
	21 and above	24	7,1
Type of School	Middle school	149	44,1
	High school	189	55,9
Educational Level	Associate Degree	1	0,3
	Bachelor Degree	271	80,1
	Master's Degree	64	19
	Doctorate	2	0,6
Working Time with the Manager	1-2	170	50,3
	3-4	102	30,2
	5 and above	66	19,5
Total		338	100
Demographic Information of Qualitative Data			
Variables		N	%
Gender	Female	12	36,4
	Male	21	63,6
Age	21-30	10	30,3
	31-40	13	39,4
	41-50	10	30,3
Teaching Seniority	1-5	12	36,5
	6-10	9	27,2
	11-15	3	9,1
	16-20	3	9,1
	21 and above	6	18,1
Type of School	Middle School	12	36,4
	High School	21	63,6
Educational Level	Bachelor's Degree	26	78,8
	Master's Degree	7	21,2
Working Time with the Manager	1-2	20	60,6
	3-4	8	24,3
	5 and above	5	15,1
Total		33	100

When Table 1 was examined, it was determined that 135 (%39.9) of the teachers participating in the research were female, and 203 (%60.1) were male. When the age group is examined, 98 teachers (%29) between the ages of 21-30, 168 teachers (%49.7) between the ages of 31-40, 69 teachers (%20.4) between the ages of 41-50, 3 teachers (% 0,9) aged 51 and above participated in the research. While 149 (%44.1) of the teachers participating in the research are working in middle school, 189 (%55.9) are working in high school. When the education levels of the teachers participating in the research were examined, it was found that the number of teachers with a bachelor's degree was 271 (%80.1), and there were 64 teachers with a master's degree (%19). While one teacher with an associate degree (%0.3) participated in the research, two teachers with a doctorate (%0.6) answered the questionnaires. The number of teachers working with their manager for 1-2 years was 170 (%50.3), the number of teachers working for 3-4 years was 102 (%30.2), and the number of teachers working for five years or above was 66 (%19.5).

When the demographic information of the qualitative data analysis in Table 1 was examined, it was seen that 21 (%63.6) of the participants were male, and 12 (%36.4) were female. While the interviews were mainly conducted with teachers between the ages of 31-40 (%39.4), it was found that the rate of teachers between the ages of 21-30 and 41-50 (%30.3) was the same. When the participant teachers were examined in terms of the seniority variable, the teachers with 1-5 years of experience (%36.5) participated the most. It was found that 21 teachers (%63.3) were working at the high school level, and 12 teachers (%36.4) were working at the middle school level. It was revealed that most interviewed teachers had bachelor's degrees (%78.8). In addition, when the variable of working time with the manager was examined, it was found that most of the teachers interviewed worked with the manager for 1-2 years (%60.6).

Data Collection

"Transformational Leadership Scale" and "Organizational Commitment Scale" were used to collect the quantitative data for the study. The transformational leadership scale was developed by Oran (2002) using the scale developed by Bass and Avolio (1992). This scale is made up of 40 items and four sub-dimensions. As a consequence of the Cronbach's Alpha reliability analysis performed after the scale was applied in this study, it was found that the overall scale had a reliability coefficient of .98. If it is between .80 and 1.00, it means that it is highly reliable (Kılıç, 2016). According to these findings, it can be said that the reliability of the scale is high. The Three-Dimensional Organizational Commitment Scale formed by Allen and Meyer (1997) was adapted as the 'Organizational Commitment Scale' by Karakuş (2005) and used in this study. This scale consists of 21 items and three sub-dimensions. When the Cronbach's Alpha coefficients of the data obtained in this study were examined, the scale was found to be .85 at the general level. It has been found that the scale has high reliability at the general level. The researcher developed a semi-structured interview form to collect qualitative data. In addition, a Personal Information Form was distributed to obtain demographic information about the participants.

Data Analysis

The data obtained in the scales were analyzed using the SPSS program. The data did not have a normal distribution, so non-parametric tests were applied. Percentage, mean, standard deviation, and minimum and maximum values were used to define the variables. Mann-Whitney and Kruskal-Wallis tests were chosen to reveal the relationship between independent variables and transformational leadership and organizational commitment. In addition, Spearman's Ranking Correlation Coefficient test was applied to reveal the relationship between transformational leadership and organizational commitment. In the qualitative aspect of the research, the content analysis technique was chosen for data analysis. Buyukozturk et al. (2018) define content analysis as a systematic technique, and some words in a text are highlighted with tiny content categories using the coding method. Categories and codes were created for each question.

FINDINGS

Findings of Quantitative Data

The perceptions of teachers about how much they reflect the transformational leadership behaviors of school managers are given in Table 2 based on the arithmetic mean and standard deviation values.

Table 2. Descriptive Values of Transformational Leadership Scale Scores

	N	Min	Max	x̄	Sd
Inspirational motivation	338	1,17	5,00	4,25	,722
Idealized influence	338	1,00	5,00	4,35	,710
Individual consideration	338	1,00	5,00	4,24	,759
Intellectual stimulation	338	1,00	5,00	4,16	,807
Total	338	1,09	5,00	4,25	,719

When Table 2 is examined, the descriptive values of the perceptions of the teachers participating in the research regarding the transformational leadership levels of their managers are seen. It was found that inspirational motivation sub-dimension x̄=4.25 (very high), idealized influence sub-dimension x̄=4.35 (very high), individual consideration sub-dimension x̄=4.24 (very high), intellectual stimulation sub-dimension x̄=4,16 (high). Moreover, it was concluded that total transformational leadership score

turned out to be x̄=4.25 (very high). Among the sub-dimensions, the highest average belongs to the idealized influence dimension, while the lowest average belongs to the intellectual stimulation sub-dimension.

Since there is no significant difference (p>.05.) between teachers' perceptions of their managers' transformational leadership behaviors and the variables, the findings are not included here.

Table 3. Kruskal-Wallis Test Results Between Transformational Leadership Scale Scores According to the Variable of Teaching Seniority

	Teaching Seniority	N	Mean Rank	Sd	X^2	P
	1-5	134	171,59	4	11,275	,024
	6-10	93	184,98			
	11-15	45	149,10			
	16-20	42	135,29			
	21+	24	195,96			

Transformational leadership sub-dimension and general level findings according to the variable of teaching seniority are given in Table 3. A significant difference was found between the total score of transformational leadership and teaching seniority: p<.05. Considering the mean rank, those who have been teaching for 21 years or more (R=195.96) have the highest score, while teachers with 16-20 years of experience (R=135.29) have the lowest score.

Table 4. Descriptive Values of Organizational Commitment Scale Scores

	N	Min	Max	x̄	Sd
Emotional Commitment	338	1,57	5,00	3,99	,74457
Continuance Commitment	338	1,29	5,00	3,50	,79602
Normative Commitment	338	1,14	5,00	3,82	,73997
Total	338	1,81	4,90	3,77	,60842

When Table 4 is examined, it has the values of emotional commitment (x̄= 3.99), continuance commitment (x̄= 3.50), normative commitment (x̄= 3.82) and organizational commitment general level (x̄= 3.77). It was seen that the teachers who participated in the research gave answers at the level of agree. Teachers stated that they were most emotionally committed to their organization (x̄= 3.99) and had continuation commitment (x̄= 3.50) the least. Since there is no significant difference (p>.05.) between teachers' organizational commitment levels according to teachers' perceptions and the variables, findings are not included here.

Table 5. The Results of Spearman's Ranking Coefficient Analysis of the Relationship Between Transformational Leadership and Organizational Commitment

Variables	N	x̄	Sd	1	2	3	4	5	6	7	8	9
1.Inspirational Motivation	338	4,25	,72	1	,852**	,839**	,861**	,935**	,361**	,326**	,441**	,470**
2.Idealized Influence	338	4,35	,71	,852**	1	,864**	,872**	,942**	,301**	,284**	,375**	,398**
3.Individual Consideration	338	4,24	,75	,839**	,864**	1	,883**	,946**	,288**	,293**	,390**	,406**
4.Intellectual Stimulation	338	4,16	,80	,861**	,872**	,883**	1	,957**	,288**	,324**	,377**	,416**
5.Total (T.L.)	338	4,25	,71	,935**	,942**	,946**	,957**	1	,324**	,325**	,414**	,444**
6.Emotional Commitment	338	3,99	,74	,361**	,301**	,288**	,288**	,324**	1	,323**	,609**	,789**
7.Continuance Commitment	338	3,50	,79	,326**	,284**	,293**	,324**	,325**	,323**	1	,422**	,735**
8.Normative Commitment	338	3,82	,73	,441**	,375**	,390**	,377**	,414**	,609**	,422**	1	,841**
9.Total (O.C.)	338	3,77	,60	,470**	,398**	,406**	,416**	,444**	,789**	,735**	,841**	1

*$p < .05$. **$p < .01$.

When Table 5 is examined, the findings regarding the relationship between transformational leadership scale scores and organizational commitment scale scores are seen. The data obtained is very weak between 0.00-0.20; between 0.20 and 0.39 is weak; between 0.40-0.59 is medium; between 0.60-0.79 is high and between 0.80-1.00 is very high. While there was a weak, significant and positive correlation between transformational leadership and emotional commitment ($r_{spearman}$=.324; p<.01), continuance commitment ($r_{spearman}$=.325; p<.01), it was concluded that there was a medium, significant and positive correlation between the normative commitment sub-dimension ($r_{spearman}$=.414; p<.01) and the general organizational commitment level ($r_{spearman}$=.444; p<.01).

Findings of Qualitative Data

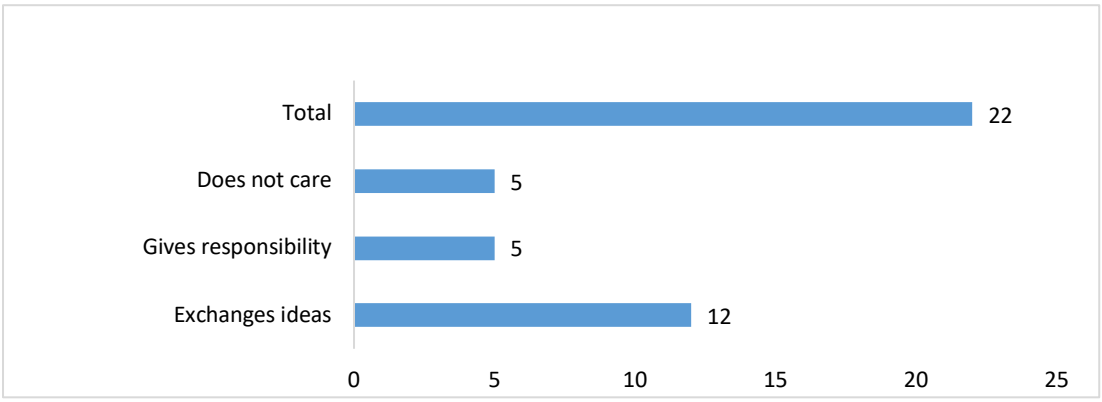

Figure 1. Inspirational Motivation

Findings for the inspirational motivation category are given in Figure 1. Teachers were asked "What does your manager do to involve you in the process of developing the school's vision and implementing the developed vision?" Teachers stated that their managers mostly exchanged ideas (N=12) to involve them in the process.

T6: He tries to manage the process by sharing his ideas and views that can contribute to the development of the school's vision and students, and by getting feedback from us in the meetings and one-on-one meetings.

In addition, some of the teachers (N=5) stated that their managers did not make an effort to develop the vision of the school and to implement the developed vision.

T5: I do not think that he attaches much importance to education and training.

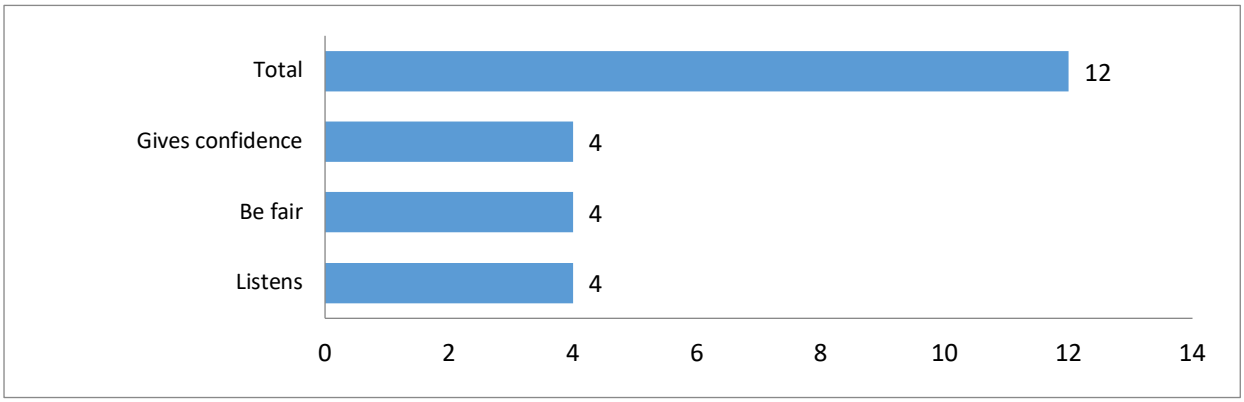

Figure 2. Idealized Influence

Findings for the idealized influence category are given in Figure 2. Teachers were asked "Which words and behaviors do you think lie behind your greater respect and trust in your manager?". In response to the question, they talked about the personality traits of their managers and their behavior towards them. It has been concluded that the managers' listening to their employees (N=4), being fair (N=4) and giving confidence (N=4) cause them to have an impact on their employees the most.

T6: Listening to everyone, caring about their ideas and trying to help as much as possible play a big role in gaining respect and trust.

On the other hand, T9 talked about how her manager's trying to help affects her thoughts.

T9: When I have a problem, my manager takes time to explain and helps me as much as possible which makes me respect and trust him.

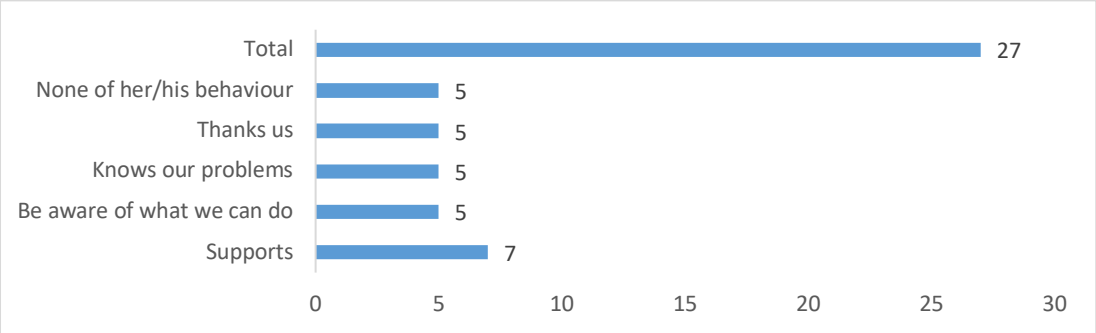

Figure 3. Individual Consideration

The findings of the individual consideration category are shown in Figure 3. Teachers were asked “On what words and behaviors do you base your manager's knowledge and encouragement of the stakeholders working in the institution?” Teachers stated that they were most interested in them because they stated that their managers supported them most (N=7).

T2: I understand that our manager is trying to encourage us since he stated that he would support us both financially and morally in any work that benefits the institution.

In addition, the fact that the managers are aware of what their employees can do (N=5), that the employees know their problems (N=5) and that they thank their employees (N=5) show that they are personally interested in them.

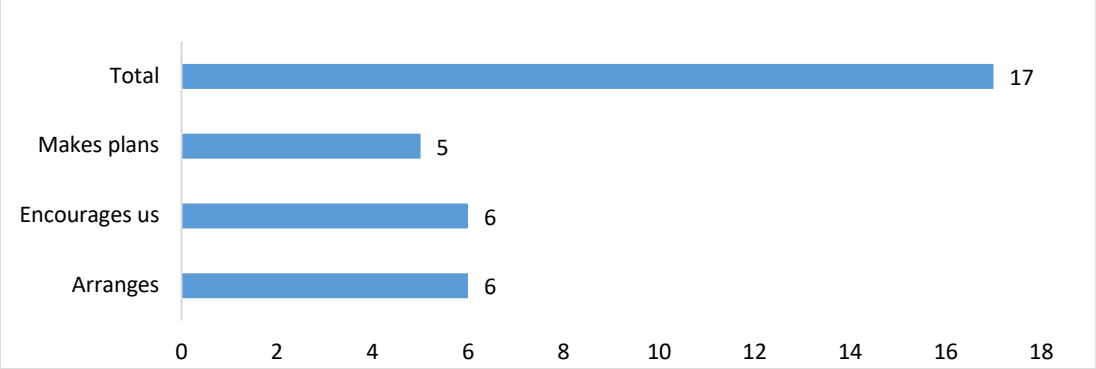

Figure 4. Intellectual Stimulation

Findings related to the intellectual stimulation category are shown in Figure 4. "With what words and behaviors do you associate your manager's concern for developing himself, the stakeholders and the institution?" were asked to the teachers.

T2: He has an effort to constantly improve and transform himself, the teachers and the institution. It aims to constantly move forward by using the physical structure of the school and the potential of the teacher within the possibilities.

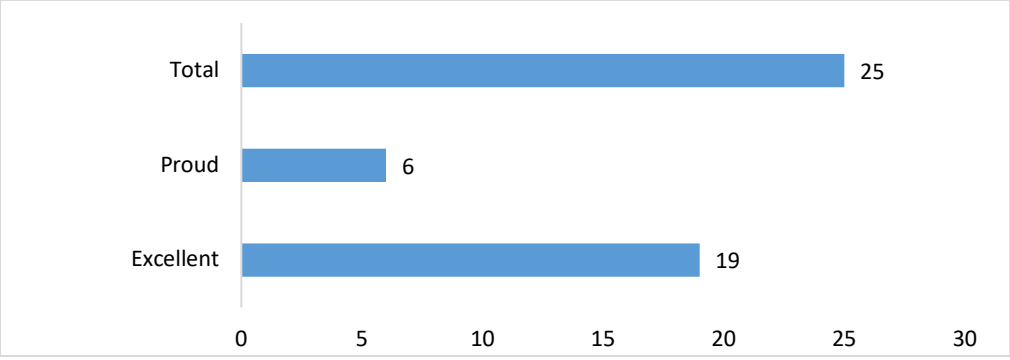

Figure 5. Emotional Commitment

The findings of the emotional commitment category are given in Figure 5. More than half of the teachers (N=19) answered the question “How does it feel to be a part of education and school?” as excellent.

T14: It's a great feeling, I wouldn't change teaching for anything. Teaching is what I enjoy most in my life.

Six of the teachers stated that they consider it proud to be a part of education and school.

T6: When we look at educational institutions as places that build our future, it is very proud to be a part of this system.

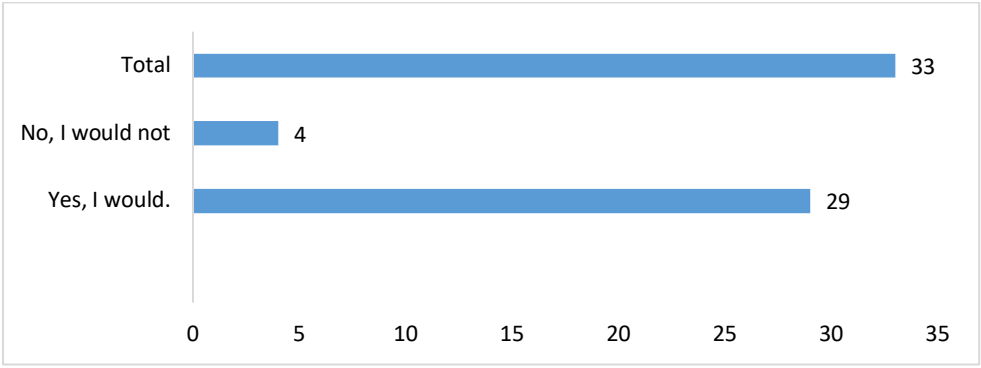

Figure 6. Continuance Commitment

The findings of the continuance commitment category are given in Figure 6. Teachers were asked "If you had the opportunity to do a job other than teaching, would you want to continue working as a teacher and why?" Majority of the teachers (N=29) said "Yes, I would."

T9: I would continue to teach. Because I love my branch and being helpful to young people while they shape their lives is a satisfying feeling.

Teachers who did not want to continue teaching stated that the value of the profession was not known or they thought that they had chosen the wrong profession.

T25: I would not want to continue being a teacher. Unfortunately, teaching is not a well-known profession in our country.

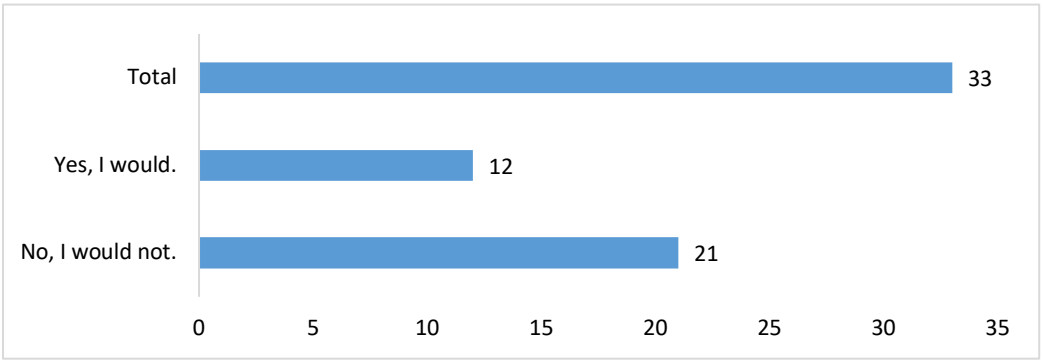

Figure 7. Normative Commitment

The findings of the normative commitment category are shown in Figure 7. Teachers were asked "What are the contributions of the institution you work for? If you had the opportunity, would you like to work in another institution or job?" Most of the teachers (N=21) stated that they did not want to work in another institution.

T13: No, I would not want to work in another institution because I am happy to be in this institution. It helped me in terms of classroom management.

Twelve of the teachers stated that they wanted to work in another institution. They claimed that they were not challenged in their institutions.

T5: I would definitely work at another school. It is not a school that forces me in terms of level. I believe that I can improve myself more in a school that challenges me in terms of level.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

When the data on how much the managers show transformational leadership behaviors according to teacher perceptions was examined, inspirational motivation, idealized influence and individual consideration averages were found to be "very high." In contrast, the "Intellectual stimulation" dimension was found to be "high." The overall scale determined that the transformational leadership levels of the institution managers who took part in the study were very high. It was determined that the highest average belonged to the idealized influence dimension while the lowest belonged to the intellectual stimulation sub-dimension. Considering these findings, the teachers participating in the research see their managers as transformational leaders. The codes obtained as a result of the analysis of the interviews with the teachers are examined. While 28 of the teachers talked about the behaviors of their managers, indicating that they have transformational leadership characteristics, 5 of them stated that their managers had no interest in this matter. This shows that the qualitative findings of the research support the quantitative findings. Erkuş and Ünlü (2008) found that the charisma (idealized influence) dimension has the highest level among the sub-dimensions in their research findings. In addition, Güneş and Buluç (2012) also found the idealized influence dimension at the highest level. This

supports the findings obtained in this study. The fact that the idealized influence sub-dimension is higher than the other sub-dimensions can be interpreted as school managers wanting to prove to their employees that they are good leaders as a source of inspiration.

When the Kruskal-Wallis test concerning the transformational leadership characteristics of school managers and the seniority of teachers was examined, a significant difference was found between inspirational motivation, idealized influence and intellectual stimulation, and the variable of seniority. The decrease in expectations from the manager as the seniority in teaching increases can explain this finding. When the literature is reviewed, it has been seen that some studies overlap with this finding. Eraslan (2003) found a significant difference between transformational leadership and teachers' seniority. Likewise, Töremen and Yasan (2010) found a significant difference between transformational leadership and seniority.

When the findings related to the teachers' commitment to the institutions they work for were examined, it was found that teachers' organizational commitment was high. However, teachers stated that they were most emotionally committed to their organizations. Compared with the findings obtained in the interview analysis, quantitative and qualitative findings support each other. It was found that 29 of the interviewed teachers were committed to their profession. Although 12 of the teachers liked their profession and school, they stated that they would work in another school if they had the opportunity due to the low level of students, the limited opportunities of the school or the fact that they did not find themselves efficient enough due to the type of institution. When the literature is examined, some studies overlap with the findings obtained from this research. Ekinci (2012) found that teachers' organizational commitment was high. This result is parallel with the result of the research. Demir (2020), on the other hand, revealed that the organizational commitment of teachers working in primary schools was at a medium level. The highest level of emotional commitment among the sub-dimensions is similar to this research.

According to Spearman's Ranking Coefficient analysis, which was performed to reveal whether there is a relationship between transformational leadership and organizational commitment, it has been revealed that there is a positive, significant and medium relationship between transformational leadership and the general level of organizational commitment. The fact that the managers are transformational leaders positively affects teachers' organizational commitment. The findings obtained in the interview analysis support this result. Twenty-eight of the teachers who participated in the study gave answers showing that they were committed to the institutions they worked for. While three teachers stated that they did not see their managers as transformational leaders, they also wanted to work in another institution.

On the other hand, two teachers stated that they wanted to continue working in the same institution, although they did not see their managers as transformational leaders. This may be because they are used to working in the institution. There are studies in the literature that have reached similar findings. Noraazian and Khalip (2016) found that transformational leadership significantly impacted teachers' organizational commitment. Şahin (2020) found that the transformational leadership behaviors of managers positively influenced teachers' organizational commitment. It has been stated that as the transformational leadership behaviors of managers increase, teachers' organizational commitment also increases. Likewise, Porter (2015), Feizi, Ebrahimi & Behehsti (2014), and Ismail, Mohamed H., Sulaiman, Mohamed M. &Yusuf (2011) found in their research that managers' transformational leadership behaviors had a positive influence on employees. This situation supports the findings obtained from the research.

As a result of the findings obtained from this research, it can be concluded that transformational leadership positively influences teachers' organizational commitment. Teacher commitment is one of the substantial factors for the institution to achieve its goals. Due to the transformational leadership behaviors exhibited by the manager, teachers' organizational commitment levels can be increased. In this case, teachers will make more efforts to make the institutions they work in successful. Changes in the manager's behavior can create a domino effect and affect teachers, students, and society.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Author contribution statements

The presented idea was conceived by the first author and developed further by the two authors. The first author reviewed the literature, collected and prepared the data for analysis, and reported the study. In order to assure consistency, analysis of the data was carried out by the two researchers. Both of the authors discussed the results and contributed to the final manuscript. The first author also translated the final manuscript, which was originally written in Turkish.

Researchers' contribution rate

The study was conducted and reported by the first author. The second author consulted the research process and reviewed the final manuscript.

Ethics Committee Approval Information

Ethical approval of this study was approved by Mardin Artuklu University Ethics Committee on July 22, 2020 (REF: 34233153-050.06.04).

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| Research Article / Araştırma Makalesi |

The Effect of Technology Assisted Argumentation Based Teaching on Technological Pedagogical Content Knowledge Self Assessments of Preservice Teachers

Teknoloji Destekli Argümantasyon Tabanlı Öğretimin Öğretmen Adaylarının Teknolojik Pedagojik Alan Bilgisi Öz Değerlendirmelerine Etkisi[1]

Samet KORKMAZ[2], Abdullah Çağrı BİBER[3]

Keywords

1. Technological pedagogical content knowledge
2. Pre-service teachers
3. Technology supported argumentation based teaching
4. Argumentation
5. Self-assessment

Anahtar Kelimeler

1. Teknolojik pedagojik alan bilgisi
2. Öğretmen adayları
3. Teknoloji destekli argümantasyon tabanlı öğretim
4. Argümantasyon
5. Öz değerlendirme

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Abstract

Purpose: This study investigates the effect of technology-supported argumentation-based teaching on pre-service teachers' Technological Pedagogical Content Knowledge (TPACK) self-assessment.

Design/Methodology/Approach: A quasi-experimental design with a pretest-posttest control group was used in the research. Participants of the study are 43 pre-service mathematics teachers who take the Analytic Geometry-I course. They were studying in the third grade in the faculty of education at a state university in Turkey in the fall semester of the 2019-2020 academic year. In the research process of the study, the subject of transformation geometry was taught to the experimental group using technology-supported argumentation-based teaching practice. The lessons are planned to last four weeks (12 lesson hours), three lessons per week. In the first week of the lessons, the translational transformation, reflection transformation in the second and third weeks, and rotational transformation in the fourth week were discussed. TPACK-SAS (self-assessment scale), which was used as a data collection tool in the study, was applied to both groups before the first week (pre-test) and after the last week (post-test).

Findings: The research findings observed that the participants' self-evaluations about TK (technology knowledge) were relatively low. In addition, it was observed that pre-service teachers' post-test mean scores regarding the sub-dimensions of PK (pedagogical knowledge), PCK (pedagogical content knowledge), and TPACK (Technological Pedagogical Content Knowledge), which mainly includes pedagogy knowledge, were high.

Highlights: As a result of the research, it was concluded that the technology-supported argumentation-based transformation geometry teaching practice did not affect the TPACK self-evaluation of the pre-service teachers in the experimental group. Studies similar to this with pre-service teachers can be carried out with students at different educational levels on transformation geometry or another mathematics subject.

Öz

Çalışmanın amacı: Bu çalışmanın amacı, teknoloji destekli argümantasyon tabanlı öğretimin öğretmen adaylarının Teknolojik Pedagojik Alan Bilgisi (TPAB) öz değerlendirmelerine etkisini araştırmaktır.

Materyal ve Yöntem: Araştırmada öntest-sontest kontrol gruplu yarı deneysel desen kullanılmıştır. Araştırmanın katılımcıları, 2019-2020 eğitim öğretim yılı güz döneminde Türkiye'de bir devlet üniversitesinin eğitim fakültesinde üçüncü sınıfta okuyan ve Analitik Geometri-I dersini alan 43 matematik öğretmeni adayıdır. Araştırma sürecinde deney grubuna teknoloji destekli argümantasyon tabanlı öğretim uygulaması kullanılarak dönüşüm geometrisi konusu işlenmiştir. Dersler dört hafta (12 ders saati), haftada 3 ders olacak şekilde planlanmıştır. Derslerin ilk haftasında öteleme dönüşümü, ikinci ve üçüncü haftalarında yansıma dönüşümü ve dördüncü haftasında dönme dönüşümü ele alınmıştır. Araştırmada veri toplama aracı olarak kullanılan TPAB-ÖDÖ (öz değerlendirme ölçeği) her iki gruba da ilk haftadan önce (ön test) ve son haftadan sonra (son test) uygulanmıştır.

Bulgular: Araştırma bulgularında, katılımcıların TB (teknoloji bilgisi) ile ilgili öz değerlendirmelerinin nispeten düşük olduğu görülmüştür. Ayrıca öğretmen adaylarının özellikle pedagoji bilgisini içeren PB (pedagojik bilgi), PAB (pedagojik alan bilgisi), TPAB (Teknolojik Pedagojik Alan Bilgisi) alt boyutlarına ilişkin son test puan ortalamalarının yüksek olduğu görülmüştür.

Önemli Vurgular: Araştırma sonucunda, teknoloji destekli argümantasyon tabanlı dönüşüm geometrisi öğretimi uygulamasının, deney grubundaki öğretmen adaylarının TPAB öz değerlendirmelerine etkisinin olmadığı sonucuna ulaşılmıştır. Öğretmen adaylarıyla gerçekleştirilen bu çalışmaya benzer çalışmalar, dönüşüm geometrisi veya matematiğin başka bir konusu üzerinde farklı eğitim düzeylerindeki öğrencilerle yapılabilir.

[1] This study has been produced from the doctoral thesis of the first author, which was conducted under the consultancy of the second author.

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INTRODUCTION

Considering the components that make up the education process, teachers who are the designers of the process and have a direct influence on the process are more prominent among other components (Demirtas et al., 2011). In this context, the issue of teacher qualification is fundamental (Darling Hammond, 2000; Rivkin et al., 2005). Shulman, known for his studies on teacher competence, claimed that there was a disconnection between the content knowledge teachers should acquire and the teaching knowledge and that there was no connection between these types of knowledge (McNamara, 2002). Shulman (1986, 1987) introduced the concept of pedagogical content knowledge (PCK), which is formed by the inclusion of pedagogical knowledge in content knowledge that determines a teacher's success in teaching.

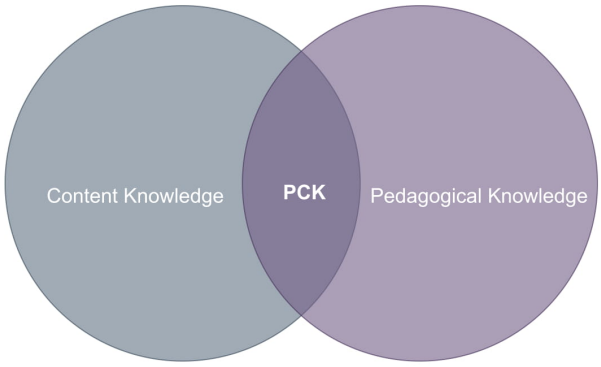

Figure 1. Pedagogical content knowledge model (Shulman, 1987)

Shulman (1987) expressed the concept of PCK as being able to explain the subject as clearly as possible for learners. For this, teachers use the most valuable representations (forms of representation), the most appropriate examples, associations by analogy and the most understandable explanations in teaching.

The PCK model has become a fundamental model in teacher education, regardless of the branch, with the studies conducted by researchers based on this model (Evens et al., 2015). The Ministry of National Education (MoNE) (2017a) states that a good teacher should have a high level of knowledge of the subjects covered by his branch and a command of the curriculum and PCK. In the field competencies of the mathematics teacher, the importance of planning an appropriate education to ensure mathematical development within the curriculum framework is emphasized. It was underlined that the knowledge about mathematics subjects in the curriculum should be mastered, and the use of appropriate tools and equipment for teaching (MoNE, 2017b).

Based on Shulman's PCK model, researchers interested in this subject investigated different type of knowledge specific to the teaching profession and the relationships between these types of knowledge. Moreover, they developed other models on the subject due to their studies (Ball et al., 2008; Fennema & Franke, 1992; Grossman, 1990; Harris et al., 2009; Marks, 1990; Niess, 2005).

One of the different models developed as a result of this research is Technological Pedagogical Content Knowledge (TPACK), which explains the teaching knowledge required for technology integration (Stoilescu, 2011; Tabach, 2011). TPACK is a new knowledge model formed by adding a technology component to the PCK model introduced by Shulman (Abbitt, 2011a; Cox, 2008; Mishra & Koehler, 2006). Today, one of the main areas affected by technology is education. Developments in science and technology necessitate integrating technology with the learning-teaching process (Liao, 2007). It is imperative to benefit from technology, which is thought to positively affect the teaching-learning process of mathematics, to conduct appropriate teaching activities for students, and to provide them with the opportunity to exchange information (National Council of Teachers of Mathematics (NCTM), 2000). Accordingly, teachers who design and manage the teaching process are expected to integrate technology into the teaching process and include technology in their lessons quite effectively (Chen, 2010). As a natural consequence of this situation, technology knowledge has been added to the areas teachers should know about (Ivy, 2011).

Mishra and Koehler (2006) describe TPACK as the intersection of content knowledge (CK), pedagogical knowledge (PK) and technological knowledge (TK). In addition to these three domains of knowledge and their intersections, they also defined the domains of knowledge they named as Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK) and Technological Pedagogical Knowledge (TPK). Here, they considered the interactions of the PK, CK and TK domains in binary combinations. In the studies (Angeli & Valanides, 2009; Mishra & Koehler, 2006; Niess, 2005; Niess et al., 2006; Niess et al., 2007), different components related to TPACK were defined, and new models have been proposed for the integration of education and technology. The model proposed by Mishra and Koehler (2006) is essential in that it forms the foundations of the theoretical framework regarding TPACK (Akkoc et al., 2011; Griggs, 2010). This model introduced by Mishra and Koehler (2006) constitutes the basic framework of TPACK in this study, which deals with the TPACK self-evaluation of pre-service teachers.

In the TPACK model suggested by Mishra and Koehler (2006), three main components are related to the teaching profession. These are the basic types of knowledge PK, CK and TK.

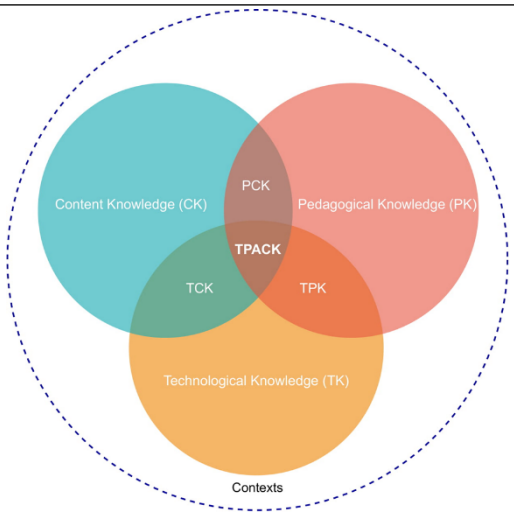

Figure 2. Mishra and Koehler's TPACK model (Koehler & Mishra, 2009)

As seen in Figure 2, the TPACK model includes seven components. Here, TPK, TCK, PCK and TPACK are the interactions of dual PK, CK and TK combinations. Here, CK is the knowledge about the content that a teacher will teach (Koehler & Mishra, 2009; Mishra & Koehler, 2006). PK is a vast field of knowledge about the practices and strategies necessary for the teaching process, the general aims of education, and the basic principles and values of teaching. TK refers to the ability of a teacher to use certain technologies (blackboard, book, chalk, etc.) found in almost every classroom, as well as computers, the internet and technologies that are constantly renewed. PCK is the field of knowledge that includes deciding which teaching methods and techniques are compatible with the subject (Koehler & Mishra, 2008; Mishra & Koehler, 2006). TCB is defined as "understanding the effects of content and technology on each other and the points where they limit each other" (Koehler & Mishra, 2008). A teacher with a deep TPK should be aware of the technologies most appropriate to the subject area and be able to identify technologies that will contribute to teaching (Harris et al., 2009; Koehler & Mishra, 2008). TPK is a type of knowledge that expresses how technology can be adapted to different learning and teaching environments appropriately (Cox, 2008; Koehler & Mishra, 2009). TPACK is a way of thinking about the complex relationships between technology, pedagogy and content. The use of content-based pedagogical knowledge is particularly emphasized in the definitions and features of TPACK, and three types of knowledge and the interaction between them are highlighted (Cox, 2008; Mishra & Koehler, 2006).

According to Niess et al. (2009), TPACK means that teachers should consider how they can teach mathematical concepts related to the subject taught and the thoughts that form the basis of these mathematical concepts in a way that students can understand by using technology and consider which way they should follow in teaching. Therefore, TPACK should be handled in a way specific to the field and the content intended to be taught (Cox & Graham, 2009; Niess, 2005; Schmidt et al., 2009). Hence, this study considers a teaching practice that blends the argumentation-based learning approach and technology, which is suitable for the subject of transformation geometry. Argumentation is putting forward some claims, explaining the connection between the data that forms the basis for these claims, and justifying the claims (Toulmin, 2003). Argumentation requires considering students' thoughts and evaluating them by comparing the underlying reasons (Reid & Knipping, 2010). The argumentation model of Toulmin (2003), which consists of six components such as data, claim, reason, qualifier, rebuttal and supporter, was taken as a basis. During the research process of the study, argumentation-based teaching practices would contribute to pre-service teachers' teaching-technology integration skills and subject knowledge.

In addition to knowledge, it is also essential for a person to be self-confident. It is difficult for people with insufficient self-confidence to use their knowledge effectively (Canturk Gunhan & Baser, 2007; Gawith, 1995). Self-assessment, also expressed as a perception of self-efficacy is an assessment of a person's potential to do any job. In other words, self-assessment is a person's belief about whether he/she can perform that job as it should (Azar, 2010; Bandura, 1997; Siegle & McCoach, 2007). Studies in the literature on the subject have shown that teachers 'self-assessment levels have an effect on designing an effective teaching process and successfully managing the process, students' success and self-assessment (Akbas & Celikkaleli, 2006; Bandura, 1997; Gurol et al., 2010; Ozdemir, 2008; Smith, 1996; Tschannen-Moran & Hoy, 2001). There are studies on TPACK self-evaluation levels of teachers and pre-service teachers. These studies also reveal that the level of self-evaluation is among the factors affecting TPACK (Abbitt, 2011b; Abbitt & Klett, 2007; Archambault & Crippen, 2009; Atasoy et al., 2015; Canbazoglu Bilici, 2012; Isman & Canan, 2008; Schmidt et al., 2009; Topcu & Masal, 2020). Based on these studies, the motivation of pre-service teachers, who are the future teachers, and their self-evaluation levels that affect their performance in the teaching process should be high.

In the literature, no research blends the argumentation-based learning approach with technology and handles the self-assessment variable related to TPACK together. Since TPACK is content-specific, it is thought this study will contribute to the relevant literature. Therefore, the study aims to investigate the effect of technology-supported argumentation-based teaching practice on pre-service teachers' TPACK self-assessment. For this aim, the main problem of the study is "What is the effect of technology-supported argumentation-based instruction on TPACK self-evaluation levels of pre-service mathematics teachers?" Sub-problems of the research are given below.

1. Is there a statistically significant difference between the TPACK self-evaluation levels of pre-service teachers in the experimental and control groups?

2. Is there a statistically significant difference between the experimental group's TPACK self-assessment pre-test and post-test scores of pre-service teachers?

METHOD

Research Pattern

In this study, quasi-experimental research design was used. The experimental research design provides the opportunity to intervene on the independent variables that are aimed to be analyzed. As a result of this intervention, it enables to determine whether there is a change in the dependent variable, and if so, in what direction. Thus, cause and effect relationships between variables can be revealed and interpreted (Cepni, 2014; Gurbuz & Sahin, 2017). Participants could not be randomly assigned to the groups because the classes in which the participants were located were pre-formed by the Dean's Office and the group sizes were not suitable for random assignment. For this reason, the study was designed as a pretest-posttest control group quasi-experimental design in which the existing classes are randomly assigned as experimental and control groups.

Participants

Participants of the study are 43 pre-service mathematics teachers who take the Analytic Geometry-I course. They were studying in the third grade in the faculty of education at a state university in Turkey, in the fall semester of 2019-2020 academic year. Participants were created by purposeful sampling. In purposeful sampling, people who are considered to be suitable to find an answer to the research problem are included in the study group (Gurbuz & Sahin, 2017; Plano Clark & Creswell, 2015). Participants could not be randomly assigned to the groups, but the branches were randomly assigned as experimental and control groups. The distribution of pre-service teachers in the experimental and control groups is presented in Table 1.

Table 1. Participants

Groups	Gender		Total
	Female	Male	
Experiment	15	6	21
Control	19	3	22
Total	34	9	43

Since the university entrance exam scores of the participants were very close to each other, it was thought that the mathematics knowledge of the groups was at a similar level. The pre-test results show that the experimental and control groups are equal to each other. The results of the independent groups t test conducted in order to compare the pre-test scores of the Technological Pedagogical Content Knowledge Self-Assessment Scale (TPACK-SAS) of the pre-service mathematics teachers in the experimental and control groups are presented in Table 2.

Table 2. T test results of TPACK-SAS pre test scores

	Groups	N	$\overline{X}$	SD	df	t	p
PK pretest	Experiment	22	5.57	0.70	41	-0.846	0.402
	Control	21	5.74	0.62			
CK pretest	Experiment	22	4.10	0.94	41	-0.274	0.785
	Control	21	4.17	0.73			
TK pretest	Experiment	22	4.50	1.20	41	-0.112	0.912
	Control	21	4.54	0.96			
TCKwT* pretest	Experiment	22	5.42	0.75	41	0.234	0.816
	Control	21	5.36	0.92			
PCK pretest	Experiment	22	5.58	0.74	41	-1.270	0.211
	Control	21	5.85	0.65			
TPACK pretest	Experiment	22	5.25	0.47	29.93	0.255	0.801
	Control	21	5.19	0.90			
TPACK-SAS pretest	Experiment	22	5.15	0.50	41	-0.470	0.641
	Control	21	5.23	0.58			

* TCKwT: Teaching content knowledge with technology. An explanation about this dimension of the scale is given under the title of data collection tool.

In Table 2, it is seen that there is no statistically significant difference between the pre-test scores of the experimental and control groups in each of the sub-dimensions that make up TPACK-SAS (p> 0.05). Accordingly, it can be said that the experimental and control groups are equivalent to each other in terms of TPACK self-assessment level before the experiment.

Data Collection Tool

For the aim of the study, TPACK-SAS developed by Kartal (2017) was used as the data collection tool. This scale consists of a total of 67 items including PK (15 items), TK (11 items), CK (8 items), TCK (5 items), TPK (10 items), PCK (11 items) and TPACK (7 items). It consists of 7 factors. Kartal (2017) conducted the validity and reliability analyzes by applying this scale to 557 pre-service teachers. As a result of these analyzes, it was seen that the TCK and TPK factors from 7 factors in the scale were combined. The new factor created by the combination of TCK and TPK factors was named as Teaching Content Knowledge with Technology (TCKwT). As a result, the scale now includes 6 factors. The reliability coefficients of the scale, both made by Kartal (2017) and calculated as a result of the analysis made in this study, are given in Table 3.

Table 3. TPACK-SAS reliability values

Factors	Cronbach alpha (α)	
	The values obtained by Kartal (2017)	The values calculated in this study
PK	0.967	0.905
TK	0.931	0.918
CK	0.930	0.804
TCKwT	0.967	0.930
PCK	0.953	0.906
TPACK	0.933	0.836
TPACK-SAS	0.980	0.945

It is seen that the values in Table 3 are greater than 0.8. Accordingly, it can be said that the scale is reliable (Kalayci, 2014).

Pilot Study, Implementation Process and Data Collection

The pilot implementation of the study was carried out in the spring semester of the 2018-2019 academic year. The study was carried out with a single group of 17 pre-service teachers studying at the same university with higher grades. The pilot implementation aimed to test the activities planned to be used in the primary implementation process. In addition, it was aimed to develop and optimize the process and to test the technology-supported argumentation-based teaching practice that the researcher and pre-service teachers will experience for the first time. Thus, technology-supported argumentation-based teaching practice was experienced, and possible problems that may occur during the primary implementation process were identified. The pilot implementation was carried out at specified times outside the current curriculum of the participants. (3 lessons per week for four weeks in total). All of the participants in the pilot practice participated in the study voluntarily. Since the GeoGebra program was used in the planned teaching practice, the lessons were taught in the computer laboratory. Since the pre-service teachers had previous knowledge and experience with GeoGebra software, there was no need for any training on using GeoGebra prior to the pilot implementation. However, the pilot process showed that the participants' knowledge of GeoGebra needed to be improved in transformation geometry activities. For this reason, before the immediate implementation, the participants in the experimental group were given two-week (4 hours in total) of GeoGebra training, 2 hours a week. GeoGebra was preferred in the study because it is easy to use, accessible, and Turkish language.

The study's first author taught the lessons in the experimental group and another lecturer in the control group. The lessons are planned to last four weeks (12 lesson hours), three lessons per week. In the first week of the lessons, the translational transformation, reflection transformation in the second and third weeks, and rotational transformation in the fourth week were discussed. TPACK-SAS, used as a data collection tool in the study, was applied to both groups before the first week (pre-test) and after the last week (post-test). In the experimental group, the lessons were taught with technology-supported argumentation-based teaching. Sixteen activities prepared by technology-supported argumentation-based teaching were used in the lessons. The activities are compatible with the transformation geometry content specified in the middle and high school mathematics curricula and included in the teacher training programs. In order to prepare activities suitable for the content, middle school and high school mathematics textbooks, textbooks used in mathematics lessons in education faculties and the relevant literature were examined. As a result of this examination, it was seen that the activities in high school mathematics books were suitable for the level of pre-service teachers and the use of GeoGebra (Altun, 2018; Emin et al., 2018; Kemancı et al., 2018; MoNE, 2017c; Unlu & Er, 2015). Therefore, it is thought that it would be appropriate to use the activities in these textbooks in studies. Some of the activities in

these textbooks were adapted for the aim of the study, and some activities were used directly. Regarding the activities, the opinions of three mathematics education experts were taken. As a result of the evaluation, it was determined that the activities were suitable for the subject of transformation geometry and technology-supported argumentation-based teaching.

The activities were projected onto a screen that all participants could see through a projection by the researcher. Thus, the pre-service teachers could follow the instructions given by the researcher. After the GeoGebra work, an argumentation process was formed by discussing the questions in the activity. Throughout the activity, the information that the pre-service teachers reached, the correlations they put forward, and their generalizations were noted on the blackboard located on the other side of the laboratory and in a position where everyone could see them.

The transformation geometry teaching in the control group was carried out with the current teaching method. The current teaching method expressed here refers to predominantly teaching through the presentation. In the control group, the content in the experimental group was taught, and the questions in the experimental group were solved. No digital technology was used in the control group, and drawings made on the classroom board were used.

Analysis of Data

The data of the study were analyzed using the licensed SPSS 22 package program at a 95% confidence level (p = 0.05). Skewness and kurtosis coefficients were examined to determine whether the data showed normal distribution. The skewness and kurtosis coefficients of the data obtained from the TPACK-SAS pre-test and post-test are presented in Table 4.

Table 4. Skewness and kurtosis coefficients of TPACK-SAS data

Groups			Mean	SD	Skewness	Kurtosis
PK	Control	Pre-test	5.57	0.70	-0.210	-0.676
		Posttest	5.65	0.58	-0.056	0.492
	Experiment	Pre-test	5.74	0.62	-0.211	-0.674
		Posttest	5.95	0.66	-1.186	1.643
CK	Control	Pre-test	4.10	0.94	0.134	1.407
		Posttest	4.37	1.01	-0.442	0.567
	Experiment	Pre-test	4.17	0.73	0.673	-0.393
		Posttest	4.46	0.84	0.119	-0.769
TK	Control	Pre-test	4.50	1.20	-0.501	-0.422
		Posttest	4.82	1.03	-0.409	0.869
	Experiment	Pre-test	4.54	0.96	-0.274	-0.763
		Posttest	4.90	0.80	-0.298	-0.985
TCKwT	Control	Pre-test	5.42	0.75	0.301	-0.754
		Posttest	5.59	0.69	-0.075	-0.274
	Experiment	Pre-test	5.36	0.92	-0.626	0.115
		Posttest	5.44	0.71	-0.691	0.464
PCK	Control	Pre-test	5.58	0.74	0.504	-0.658
		Posttest	5.67	0.67	0.513	-0.238
	Experiment	Pre-test	5.85	0.65	-0.126	-0.666
		Posttest	5.75	0.53	-0.177	-0.206
TPACK	Control	Pre-test	5.25	0.47	0.437	-0.103
		Posttest	5.34	0.63	0.188	-0.165
	Experiment	Pre-test	5.19	0.90	-0.602	0.643
		Posttest	5.54	0.78	-0.631	-0.579
TPACK-SAS	Control	Pre-test	5.15	0.50	0.278	-0.415
		Posttest	5.32	0.48	-0.340	-0.619
	Experiment	Pre-test	5.23	0.58	0.123	-0.936
		Posttest	5.41	0.59	-0.606	0.284

It is seen that the skewness and kurtosis coefficients presented in Table 4 are between -2 and +2 values. It can be said that the data are distributed normally if the skewness and kurtosis coefficients are between -2 and +2 (George & Mallery, 2020). Accordingly, in the analysis of TPACK-SAS pre-test and post-test data, independent groups t-test was used to make comparison between groups, and dependent groups t-test was used for in-group comparison. When interpreting arithmetic means, 1.00-3.00 range is considered as "low level", 3.01-5.00 range as "medium level" and 5.01-7.00 range is considered as "high level" (Tekin, 2007).

In cases where a statistically significant difference was detected as a result of the t tests, the effect size (Cohen d) was calculated to examine and interpret this significance more effectively. Cohen d statistic is not affected by the sample size. Thus, it enables the analysis results to be interpreted more effectively (Ozsoy & Ozsoy, 2013; Yildirim & Yildirim, 2011). According to Cohen (1988), if the effect size is less than 0.2, it is evaluated as a weak (small) effect, if it is greater than 0.8, it is evaluated as a strong (large) effect (Yildirim & Yildirim, 2011). On the other hand, Leech, Barrett, and Morgan (2008) stated that, in addition to this assessment of Cohen (1988), an effect size of 1 or more can be interpreted as a very large effect.

FINDINGS

In order to examine whether technology-supported argumentation-based instruction has an effect on TPACK self-evaluation level, TPACK-SAS post-test scores of experimental and control groups were compared. In addition to this comparison between the groups, TPACK-SAS pre-test and post-test scores (within the group) of the experimental group were also compared. Independent groups t test results made in order to compare the posttest scores of the pre-service teachers in the experimental and control groups regarding the sub-dimensions that make up the TPACK-SAS are presented in Table 5.

Table 5. T test results of TPACK-SAS sub-dimensions post test scores

	Groups	N	$\overline{X}$	SD	df	t	p
PK posttest	Control	22	5.65	0.58	41	-1.602	0.117
	Experiment	21	5.95	0.66			
CK posttest	Control	22	4.37	1.01	41	-0.334	0.740
	Experiment	21	4.46	0.84			
TK posttest	Control	22	4.82	1.03	41	-0.277	0.783
	Experiment	21	4.90	0.80			
TCKwT posttest	Control	22	5.59	0.69	40.76	0.727	0.471
	Experiment	21	5.44	0.71			
PCK posttest	Control	22	5.67	0.67	41	-0.408	0.685
	Experiment	21	5.75	0.53			
TPACK posttest	Control	22	5.34	0.63	41	-0.958	0.344
	Experiment	21	5.54	0.78			

When Table 5 is examined, it is seen that there is no statistically significant difference between the posttest scores of the experimental and control groups regarding the sub-dimensions that make up the TPACK-SAS ($p > 0.05$). In addition, when the averages in the sub-dimensions were examined, it was seen that the pre-service teachers in both groups had the lowest average in the CK sub-dimension and the highest average in the PCK sub-dimension. When the sub-dimensions with a low average are examined, it is seen that TK comes right after CK in both groups. It was determined that the averages of the sub-dimensions PK, PCK, TPACK, which include pedagogy knowledge, are above 5. Independent groups t test results made in order to compare the posttest scores are presented in Table 6.

Table 6. T test results of TPACK-SAS post test scores

	Groups	N	$\overline{X}$	SD	df	t	p
TPACK-SAS Post Test	Control	22	5.32	0.48	41	-0.555	0.582
	Experiment	21	5.41	0.59			

When Table 6 is examined, it is seen that there is no statistically significant difference between the post-test average of the experimental group and the post-test average of the control group ($t = -0.555$; $p > 0.05$). Y It is understood from the results of the t test that technology supported argumentation based transformation geometry teaching does not have a statistically significant effect on pre-service teachers' TPACK self-evaluation levels. In addition, it was observed that the TPACK-SAS post-test mean scores of pre-service teachers were above 5 for both groups.

The dependent groups t test results, which were made in order to compare the pre-test and post-test scores (within the group) of the pre-service teachers in the experimental group regarding the sub-dimensions that make up the TPACK-SAS are presented in Table 7.

Table 7. T test results of TPACK-SAS sub-dimensions pre and post test scores

	Test	N	$\overline{X}$	SD	df	t	p
PK	Posttest	21	5.95	0.66	20	1.484	0.153
	Pre-test	21	5.74	0.62			
CK	Posttest	21	4.46	0.84	20	1.779	0.090
	Pre-test	21	4.17	0.73			
TK	Posttest	21	4.90	0.80	20	3.204	0.004
	Pre-test	21	4.54	0.96			
TCKwT	Posttest	21	5.44	0.71	20	0.511	0.615
	Pre-test	21	5.36	0.92			
PCK	Posttest	21	5.75	0.53	20	-0.713	0.484
	Pre-test	21	5.85	0.65			
TPACK	Posttest	21	5.54	0.78	20	2.036	0.055
	Pre-test	21	5.19	0.90			

When Table 7 is examined, it is seen that p values are greater than 0.05 except for TK sub-dimension. This shows that there is no statistically significant difference between pre-test and post-test scores for sub-dimensions except TK sub-dimension (p> 0.05). Table 7 indicates that the difference between pretest and posttest scores for only the TK sub-dimension is statistically significant (t = 3.204; p <0.05). From here, it can be said that technology-supported argumentation-based transformation geometry teaching has an effect on the self-evaluation levels of the pre-service teachers in the experimental group regarding TK, which is one of the TPACK components. In order to examine and interpret this finding more effectively, the effect size (Cohen d) was calculated.

$$d = \frac{t}{\sqrt{N}} = \frac{3{,}204}{\sqrt{21}} = 0{,}699$$

The value of d = 0.699 shows that the effect of technology-supported argumentation-based instruction on the self-assessment of TK of pre-service teachers in the experimental group is at a moderate level.

The dependent groups t test results regarding the whole TPACK-SAS of the pre-service teachers in the experimental group are presented in Table 8.

Table 8. T test results of TPACK-SAS pre and post test scores

	Test	N	$\overline{X}$	SD	df	t	p
TPACK-SAS	Posttest	21	5.41	0.59	20	1.683	0.108
	Pretest	21	5.23	0.58			

When Table 8 is examined, it is seen that there is no statistically significant difference between the experimental group's TPACK-SAS post-test average and pre-test average (t = 1.683; p> 0.05). In other words, it can be said that technology-assisted argumentation-based transformation geometry teaching does not have a statistically significant effect on the TPACK self-evaluation levels of pre-service teachers in the experimental group.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This study investigates the effect of technology-supported argumentation-based teaching on pre-service teachers' TPACK self-assessment. It was determined that there was no statistically significant difference between the TPACK-SAS post-test averages. Canbazoglu Bilici (2012) conducted a two-stage study with pre-service science teachers. In the first stage, the participants' TPACK self-efficacy levels were detected, and no increase was observed in the second stage. This result reached by Canbazoglu Bilici (2012) in the second stage of her study coincides with the result reached in this study.

It was observed that pre-service teachers' post-test mean scores were high, especially in the sub-dimensions of PK, PCK, and TPACK, which included pedagogy knowledge. Similarly, in their study with senior-year education faculty students, Sad, Acikgul, and Delican (2015) concluded that scores requiring pedagogy knowledge are higher than others. In another study, Landry (2010) reached a similar conclusion regarding the TK knowledge field in her study with middle school mathematics teachers. Self-assessment averages for TK were relatively lower than other dimensions. This was also revealed by Archambault and Crippen

(2009) in their study with teachers about the TPACK model. The same study determined that teachers have high confidence in PK and PCK, similar to the results obtained in this study.

It was determined that there was a statistically significant difference between the pre-test and post-test scores of the pre-service teachers in the experimental group only for the TK sub-dimension. It was observed that the effect of technology-supported argumentation-based instruction on this was moderate. Different from the result here, Atasoy et al. (2015) stated in their study that there was an increase in self-efficacy related to TPK and TCK components. The researchers stated that these increases may have resulted from the decrease in pre-service teachers' anxiety about integrating technology into the teaching process and the fact that they encountered exemplary activities related to teaching-technology integration. Contrary to Atasoy et al. (2015)'s work, in this study, it was seen that the increase in self-evaluations about TCKwT did not make a statistical meaning. It is thought that this situation is due to the pre-service teachers' evaluations of TPACK needing to be made aware of their actual situation.

In the study, a significant increase was observed in TK. However, it is noteworthy that the mean scores for TK are lower than other components before and after the practice. As Topcu and Masal (2020) stated, this situation may be attributed to the need for more mathematics teachers regarding technical details such as hardware and software. Significant increases in self-assessment regarding TK can be explained by the contribution GeoGebra activities provide to pre-service teachers' technological self-confidence. However, considering that the self-evaluation regarding TK is at a medium level after the implementation process, this contribution is not at the expected level.

It was concluded that the technology-supported argumentation-based transformation geometry teaching practice did not affect the experimental group teachers' self-evaluations regarding TCKwT and TPACK. More comprehensive and detailed studies can be conducted to investigate the causes of this situation.

This teaching practice requires the design of activities suitable for the argumentation process and teaching-technology integration. Therefore, developing pre-service teachers' skills to design such activities is essential. In this context, pre-service teachers' ability to design such activities can be examined, and practice can be made to improve these skills.

In the research findings, the self-evaluation of the pre-service teachers about TK was relatively low. Teachers should have a good knowledge of technology to teach using technology. Studies similar to this with pre-service teachers can be carried out with students at different educational levels on transformation geometry or another mathematics subject.

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Statements of publication ethics

I/We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The first and the second author jointly carried out the processes of conceptualization of the theoretical framework, the determination of the research questions and the design of the method. The first author carried out the processes of data collection, data analysis and discussion of the results under the supervision of the second author. The first author wrote a Turkish draft of the manuscript on which both authors worked in cooperation. The second author edited the English version. The first author applied the article template before submission, and submitted the manuscript to the journal.

Ethics Committee Approval Information

The study is derived from the first author's doctoral thesis. The research process started in 2017 and the data were obtained before 2020 (2019-2020 Fall Semester). For this reason, the research is among the studies that do not require ethics committee approval.

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| Research Article / Araştırma Makalesi |

A Mixture Rasch Model Analysis of Mathematics Achievement

Matematik Başarısının Karma Rasch Model ile Analizi

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Keywords

1. Mixed item response theory
2. Mixture Rasch model
3. Mathematics achievement

Anahtar Kelimeler

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Abstract

Purpose: This study aims to determine distinct latent classes in 8th-grade students' mathematics achievement

Design: The research study group consisted of 435 students who received the first booklet at the TIMSS 2015 8th grade mathematics achievement test. A mixture of Rasch model analysis was used to find the best-fitting model.

Findings: When model fit indices were evaluated, the model fitting the data was found to be MRM with the two latent classes. According to this model, students in latent class 2 are more successful in mathematics than students in latent class 1. The vast majority of the items are found easier in latent class 2.

Highlights: In addition, the cognitive domain of the more accessible items for students in both classes is “knowing, while items that are difficult for both groups are in the “applying” cognitive domain.

Öz

Çalışmanın amacı: Bu çalışmanın amacı, 8. sınıf öğrencilerinin matematik başarılarındaki farklı örtük sınıfları belirlemektir.

Materyal ve Yöntem: Araştırmanın çalışma grubu, TIMSS 2015 8. sınıf matematik başarı testinde ilk kitapçığı alan 435 öğrenciden oluşmaktadır. Veriye en uygun modeli bulmak için karma Rasch model (KRM) analizi kullanılmıştır.

Bulgular: . Model uyum indeksleri değerlendirildiğinde, verilere en iyi uyan modelin iki örtük sınıflı KRM olduğu görülmüştür. Bu modele göre, 2. örtük sınıftaki öğrenciler matematikte 1. örtük sınıftaki öğrencilere göre daha başarılıdır. Maddelerin büyük çoğunluğu 2. sınıftaki öğrencilere daha kolay gelmiştir.

Önemli Vurgular: Ayrıca, her iki sınıfta da öğrencilere kolay gelen maddelerin bilişsel alanı "bilmek" iken, iki grup için zor olan maddeler “uygulama” bilişsel alanındadır.

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INTRODUCTION

Standard Rasch model (Rasch, 1960/1980) is unidimensional and as an assumption in this model people on the same ability level are comparable, that is, examinees with the same parameters are expected to have similar comments about their ability levels, skills and mental processes. On the other hand, studies show that persons at the same trait level, having the same measures on the construct, may use different processes, strategies, and operations to access the solutions (Baghaei & Carstensen, 2013; Mislevy & Verhelst, 1990; Cohen & Bolt, 2005; Ölmez & Cohen, 2018; Rost, 1990). This means that the trait and its meaning differentiate individuals depending on the processes and strategies they use to solve the items or problems; therefore, this can be seen as a significant threat to construct validity (Baghaei & Carstensen, 2013).

Relevant classes are determined according to the processes, strategies and operations individuals use to answer the items. If examinees with similar trait levels have different interpretations regarding the mechanisms and strategies, comparing people on a common ability continuum is not applicable. In other words, the underlying constructs measured by the instrument are different for different subpopulations of individuals, and the comparison of these individuals from different classes is not justifiable. (Embretson, 2007; Glück & Spiel, 2007; Rost, Carstensen, & von Davier, 1997).

In cognitive psychology, people with the same performance level may have qualitatively different strategies which underlie their performance. These qualitative differences among the individuals mean that construct representation also differs for them. When two or more latent class exists, different strategies, components, and knowledge structures in performance may lead to different orders of item difficulties. That is the nature of the trait bases on the class to which the person belongs. In this situation, the test measuring the construct may have different correlation coefficients from other measures. So, group membership is a moderator variable which is evidence for the changing meaning of the trait (Embretson, 2007).

Mixture item response theory models (MixIRT) combine item response theory (IRT) and latent class analysis (LCA), and they are used in analyzing item response data that may violate underlying assumptions of both or any of the modeling approaches (Rost, 1990). The most commonly used MixIRT model is the mixture Rasch model (MRM), and the underlying assumptions of Rasch and LCA models are briefly mentioned following (Li, Jiao, & Macready, 2016).

In the Rasch model, item difficulties must be constant for all individuals as a vital requirement, but in some cases, it may be violated for some items. Besides, items may have differing difficulties for different subgroups of individuals because the strategies of solving items they use are different, or they may have differentiating cognitive structures. Hence, a latent class approach and item analysis might be preferable. Also, in LCA models, the requirement is holding response probabilities for all individuals in the same latent class. However, various latent classes are necessary for determining individual ability differences for every cognitive construct or solution process. Accordingly, a generalized LCA model which allows varying ability levels within the latent class would be agreeable (Rost, 1990).

This study aims to determine the latent classes using the MRM and based on the TIMSS 2015 mathematical data. So, the items' properties according to these latent classes can be examined. This way, latent classes and students' latent class memberships can be determined simultaneously without solid assumptions about the Standard Rasch Model and Latent Class Analysis.

TIMSS (Trends in International Mathematics-Science Study) is a screening study conducted by the International Association for the Evaluation of Educational Achievement (IEA) in science and mathematics fields every four years. The TIMSS research aims to determine the knowledge and skills of the countries' 4th and 8th-grade students. Turkey participates in TIMSS to evaluate students' success in international fields and to compare its current educational system with those in other countries (Ministry of National Education [MoNE], 2016).

TIMSS provides participant countries various resources so the interferences in their studies and educational programs can be tested and commented on results. TIMSS includes achievement tests and questionnaires that students are asked about their school characteristics and teachers. These tests and questionnaires are used to collect information about student's performance in science and mathematics, educational systems, student characteristics, and characteristics of teachers and schools.

As a large-scale assessment study, TIMSS provides opportunities for researchers to determine the relationship between countries' education systems and students' success, compare countries in terms of their math and science success levels, and determine students' success and factors that affect student's success (MoNE, 2016; Tavşancıl & Yalcin, 2015). So, the TIMSS enables countries to evaluate students' mathematics achievement levels in terms of process and class level.

In the following, the Standard Rasch model and MRM used in the analysis are briefly explained.

The Rasch Model

For this purpose, item response models were developed, which differ according to several parameters used to describe items. In IRT models, the probability of an examinee answering an item correctly depending on the latent ability underlying the construct and characteristics of the item is determined (Hambleton, Swaminathan & Rogers, 1991). In the Rasch Model, one of the most commonly used IRT models, individual abilities and item difficulties are located on a standard scale. Therefore, an individual's probability of answering an item correctly is estimated by a function of the difference between the individual's latent ability and the difficulty of that item. (Rasch, 1960/1980). The mathematical representation of this function is given as follows:

$$P(x = 1|\theta j, \beta i) = \frac{\exp(\theta j - \beta i)}{1 + \exp(\theta j - \beta i)}$$

Where, examinee j's latent ability parameter is θ_j and the difficulty of item parameter is β_i. It is expected that the probability of giving correct answers is relatively higher for individuals with higher ability levels and/or easier items.

The Mixture Rasch Model

MRM combines the Rasch model and latent class analysis and it defines latent classes that the Rasch model is applied individually (Rost, 1990). In MRM it is assumed that the population is consist of different latent classes and for each classes item parameters may differ.

When items' difficulty patterns consistently differ among classes of population, MRM can fit the data. Rasch model is unidimensional and when it does not fit all the population, MRM allowing item parameters to differentiate among classes of this population can be chosen (Rost, 1990; Rost & von Davier, 1995). When the population is heterogeneous unavoidably, instead of rejecting the entire Rasch unscalable dataset, by considering different cognitive strategies for latent classes of population MRM may be used (Rost, 1990).

In MRM the correct response probability to an item is a function of both the examinee's ability which is a continuous variable and the categorical grouping variable regarding the set of strategies used for solution.

In MRM, for each latent class separate item difficulty parameters and for each examinee probability of assignment to particular latent class are estimated. Dichotomous i.e. scored in two categories MRM's mathematical representation is given as follows:

$$P(xij = 1|g, \theta jg,) = \frac{\exp(\theta jg - \beta ig)}{1 + \exp(\theta jg - \beta ig)}$$

where, the correct response probability to an item is P, g is an index indicating the latent class (g = 1, 2, …, G), and within class g examinee j's latent ability is θ_{jg} and for the class g item difficulty parameter is β_{ig}.

As a mixed distribution model, the MRM is a promising way to take into account qualitative individual differences without requiring the strong and necessary assumptions of the underlying non-mixed models (Rost, 1990).

In this study it is aimed to apply MRM to the TIMSS 2015 math test for determining seperate latent classes regarding math success among 8th grade students that vary in their item level patterns, if any. Thus, it can be examined whether the latent classes imply different response patterns, and also the properties of latent classes and the properties of items changing according to these latent classes. Besides these, the applications of MRM in scale validation by identifying qualitatively different latent classes are can be demonstrated. As stated Baghaei and Carstensen (2013), the presence of latent classes leads problems in interpretation and generalization of test scores and therefore it is a problem for test validity. So, the findings of this study can be useful for researchers who need to the interpretation math scores for revising or developing interested construct theories.

METHOD

Participants and Instrument

About half of the items in TIMSS 2015 are multiple-choice, and half are constructed items having long/short answers. In both classes (4th and 8th grades), science and mathematics items consist of 28 blocks. Of these blocks, 14 are science, and 14 are math blocks. These blocks were distributed to 14 test booklets in four blocks, two of which were science and two were mathematics. One of the two blocks in science and mathematics is expected between two booklets for test equating between forms (MoNE, 2016). For the study, the first booklet was chosen to apply the MRM.

The study sample consisted of 435 Turkish 8th-grade students (207 girls, 228 boys) answering booklet one item of Mathematics test in TIMSS 2015.

The booklet test includes 35 items scored dichotomously and partially credited. For using MRM in the analysis, items that scored partially credited were recoded dichotomously as 1-0. After recording these items, the unidimensionality assumption was checked with confirmatory factor analysis using diagonal weighted least square estimation in LISREL (ver. 8.80). The items having factor loadings of less than 0.30 and non-significant t-values were excluded from the test. It was seen that the unidimensional model fit the data over the remaining 28 items.

Data Analysis

The pattern of responses to 28 math items was analyzed using WINMIRA (von Davier, 2001). The number of latent classes was determined by an exploratory MRM analysis. Then, the parsimonious model that best fits the data was chosen. For this purpose, one, two, three and four latent class MRM analyzes were performed on the data and three information indices were compared to select the most appropriate model: “Akaike’s information criterion (AIC; Akaike, 1974), the Bayesian information criterion (BIC; Schwarz, 1978), and the consistent AIC (CAIC; Bozdogan, 1987). These criteria are computed as follows:

$$AIC = - 2 \log L + 2 p$$

$$BIC = - 2 \log L + p (\log N)$$

$$CAIC = - 2 \log L + p (\log N + 1)$$

where L is the likelihood, N is sample size and p is the number of estimated parameters in the model. AIC is not asymptotically consistent as sample size is not used in its calculation. BIC and CAIC select the models with fewer parameters compared to AIC. Models which have the lowest information criteria are selected in this study."

In addition to these information criteria, Q-index giving information about item fit was also estimated in WINMIRA. The item Q−index (Rost and von Davier, 1994) is calculated depending on Rasch model's parameter separability and conditional inference features (von Davier, 2001). The item−Q is estimated according to the log−likelihood of the observed item pattern. The Q index ranges from 0 to 1, a value of 0 indicates perfect fit, 0.50 indicates no relationship between item-measured features, and a value of 1 indicates negative discrimination. The standardized Q index, Zq, is the form of Q with a mean of 0 and a variance of unity. The widely used ±1.96 limit of the 95% confidence interval is applicable to the standardized Q index (Baghaei & Carstensen, 2013).

FINDINGS

Unidimensionality for the Test

Confirmatory Factor Analysis (CFA) was conducted to test the unidimensionality of the mathematics achievement test consisting of 35 items in booklet 1. According to Büyüköztürk (2018), 0.30 is sufficient as the lower limit for the factor loading values to be valid. Therefore, items with factor loadings below 0.30 in CFA were hierarchically excluded from the scale and analyzes were repeated. Seven items with factor loadings below 0.30 were excluded from the analysis. Accordingly, the standardized factor loading values for the items in the model obtained from CFA is more significant than 0.30. In the evaluation of the unidimensionality, in addition to the factor loadings, Comparative Fit Index (CFI), Normed Fit Index (NFI), Nonnormed Fit Index (NNFI) and Root Mean Square Error Index (RMSEA) compliance index values were calculated. For CFI, NFI and NNFI indices, 0.90 indicates acceptable fit, and 0.95 indicates perfect fit (Bentler & Bonett, 1980; Hooper, Coughlan & Mullen, 2008). For RMSEA, 0.08 is considered acceptable, and 0.05 is an excellent fit (Cheung & Rensvold, 2002; Marcoulides & Yuan, 2016). When fit indices for this model were examined, it was seen that CFI = 0.994, NFI = 0.982, NNFI = 0.993 and RMSEA = 0.033. When the perfect and acceptable fit criteria for fit indices are considered, it was seen that the fit indices obtained from CFA were sufficient. In the last case, the model fit data for unidimensionality was achieved.

Model Selection - Number of Latent Classes

Information criteria values for models with one, two, three and four classes required to identify to the convenient number of latent classes are given in Table 1.

Table 1. MRM Model fit Indices

Model	AIC	BIC	CAIC
One Class	12978.33	13096.52	13125.52
Two Classes	12767.46	13007.90	13066.90
Three Classes	12653.14	13015.84	13104.84
Four Classes	12659.94	13144.90	13263.90

When the AIC, BIC and CAIC values given in Table 1 for the four models were examined, it was seen the smallest BIC and CAIC values belong to a two-class MRM. However, the three-class MRM has the smallest AIC information criterion. It was decided that the data fit to the two-class MRM which is having the smallest values the BIC and CAIC information criteria which are more often recommended in the researches (Read & Cressie, 1988; Rost, 1996). For the best fitting model, latent class proportions and mean assignment probabilities were given in Table 2.

Table 2. *Two-Class MRM Mean Assignment Probabilities*

Latent Class	Latent Class proportions	Mean assignment probability	
		Class 1	Class 2
Class1	0,598	0,952	0,048
Class2	0,402	0,034	0,966

From Table 2, we see that latent class1, latent class2 proportions and mean assignment probability. Mean assignment probabilities of the students in latent class1 and latent class2 are 95.2 and 96.6 percent respectively. It can also be said that the two-class MRM has high mean assignment probabilities for both classes. According to the table 2, 260 (%59.8) of the students are in class 1 and 175 (%40.2) are in class 2.

The order of some items according to their difficulty parameters is presented in Figure 1. Specifically, the most difficult items, the easiest items and items with varying degrees of difficulties or between classes 1 and 2 are given in Figure 1.

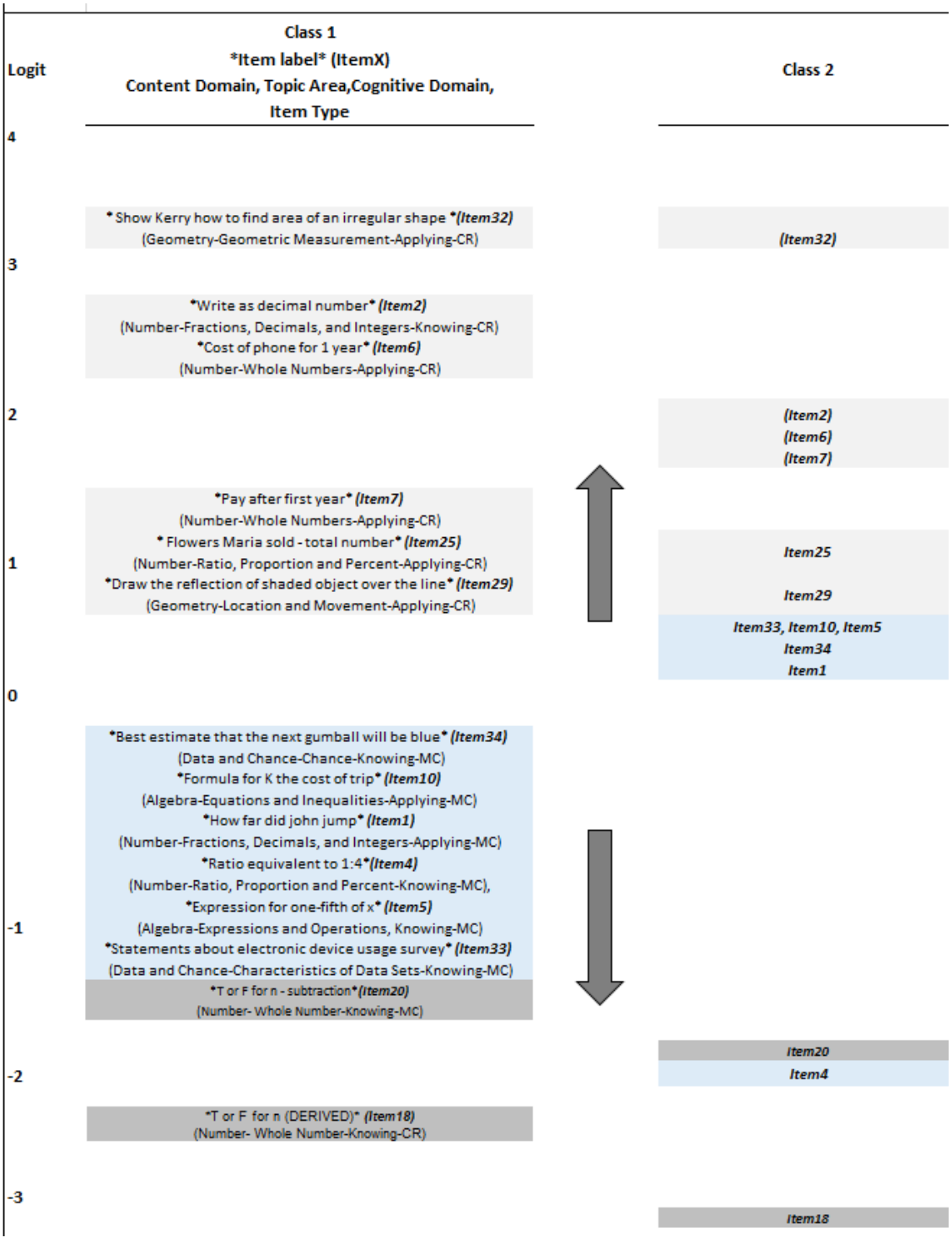

Figure 1. Ordering items according to their difficulty parameters in each latent class. Note: MC: Multiple Choice, CR: Constructed Reponses.

From Figure 1, items 32, 2, 6, 7, 25 and 29 for class 1 and class 2, respectively, were found similar and relatively more difficult than other items. While the content domains and topic areas of these items can be different, cognitive domains and item types are the same for all. The cognitive domains of the items (except item 2) are “Applying”, the item types are “Constructed Response”.

Specially, the most difficult item in both classes is item 32. This item "Show Kerry how to find area of an irregular shape" is geometry content domain that requires geometry measurement.

Items 34, 10, 1, 4, 5 and 33 were identified as relatively easy items in both classes. This situation can be interpreted in more detail as follows; Items 34, 10, 1, 5 and 33 were found to be more difficult in latent class2 than in latent class1, whereas item 4 was easier in latent class 1. When the cognitive domains and item types of these items differ in their difficulty levels in both classes, cognitive domains of all items except the 10th and 1st items are "Knowing", all of items are "Multiple Choice".

The items that are easier for students in both classes compared to other items are 20th and 18th items. The content domains of these items are "Number", cognitive domains are "Knowing".

Figure 2 shows item difficulty parameters for two latent classes. Horizontal axis shows the 28 items from 1 to 35, while the vertical axis shows the logit difficulty scale.

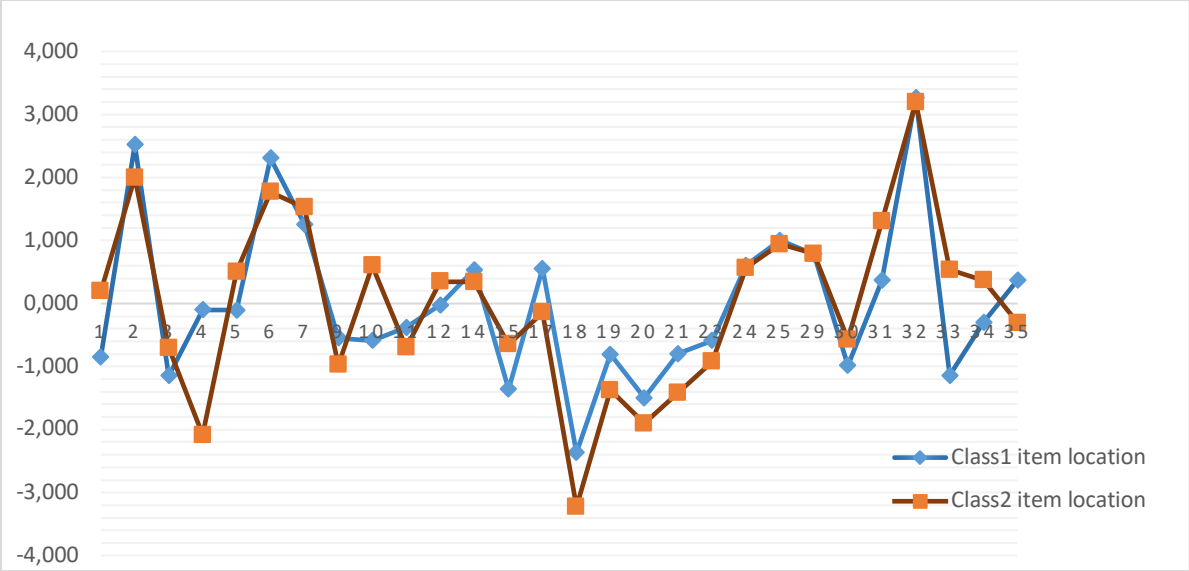

Figure 2. Item difficulty parameters for class 1 and class 2

When the figure is examined, it is seen that the some of items in the two latent classes have different difficulty parameters. The majority of the items (2, 4, 6, 9, 11, 14, items between 17-21, 23, 24, 25, 29, 32 and 35) are found easier in latent class2 than in latent class1. The others were easier for latent class 1. In this case, we can say that the test is easier for latent class2 or more difficult for latent class1. Especially, the difficulty parameters of item14, item24, item25, item29 and item32 between classes are very close to each other, that is, they have similar difficulty levels in both latent classes. While content areas of these items are "Geometry" (item 14, item 29 and item 32) and "Number" (item 24 and item 25), their cognitive domains are "Reasoning" (item 14) and "Applying" (item 24, item 25, item 29 and item 32).

The Relationships Between Latent Classes

In order to determine whether the latent classes obtained as a result of MRM differ significantly or not, it was performed for independent samples t-test. The t-test results of mathematics test scores according to the classes are given in Table 3.

Table 3. Mathematic test scores by class t-test results

Class	N	$\bar{X}$	Std. Deviation	df	t	p	η^2
Class 1	260	-1,255	0,58	433	30,406	0,00	0,681
Class 2	175	1,184	1,084				

As shown in from Table 3, it was seen that math scores differed significantly for latent classes, t (433) = 30,406, p <.01. In other words, the mean of class2 (M = 1.184, SD = 1.084) is significantly higher than the mean score of class1 (M = -1.255, SD = 0.58). When the explained variance η^2 value is examined, it is seen that 68% of the total mathematics achievement variance which is the dependent variable, is explained by the difference between latent classes. For η^2, also called effect size, the value calculated in this study is interpreted as a large effect size (0.01 low, 0.6 medium, and 0.14 high).

This finding is consistent with the findings about item parameters, such that that the majority of the items are found easier in latent class 2. So, it can be concluded that the second latent class is more successful in mathematics than the first class.

Item Fit for Each Latent Class

Lastly, in addition to model data fit, item level fit was examined with Q index (Rost &Davier, 1994). Item fit statistics were determined by the Q index and Z_q are given Table 4.

Table 4. Item fit statistics in two latent Classes

	Class 1		Class 2	
Item Label	Q-index (Zq)	p(X>Zq)	Q-index (Zq)	p(X>Zq)
I1	0,352 (0,220)	0,413	0,235 (0,595)	0,276
I2	0,339 (-0,078)	0,531	0,221 (-0,139)	0,555
I3	0,336 (0,154)	0,438	0,233 (0,414)	0,339
I4	0,329 (-0,100)	0,539	0,293 (0,103)	0,459
I5	0,346 (0,068)	0,472	0,175 (-0,413)	0,660
I6	0,216 (-0,735)	0,768	0,258 (0,497)	0,310
I7	0,273 (-0,425)	0,664	0,218 (0,036)	0,486
I9	0,361 (0,255)	0,399	0,196 (-0,210)	0,583
I10	0,393 (0,680)	0,248	0,180 (-0,260)	0,603
I11	0,332 (0,021)	0,491	0,192 (-0,158)	0,563
I13	0,278 (-0,452)	0,674	0,209 (0,280)	0,390
I14	0,325 (-0,423)	0,663	0,247 (0,520)	0,301
I15	0,291 (-0,456)	0,675	0,224 (0,220)	0,413
I17	0,226 (-1,133)	0,871	0,222 (0,218)	0,414
I18	0,352 (0,323)	0,373	0,199 (-0,083)	0,533
I19	0,369 (0,456)	0,324	0,255 (0,283)	0,389
I20	0,343 (0,254)	0,399	0,182 (-0,239)	0,594
I21	0,437 (1,128)	0,129	0,205 (-0,145)	0,558
I23	0,302 (-0,174)	0,569	0,264 (0,655)	0,256
I24	0,204 (-1,260)	0,896	0,184 (-0,264)	0,604
I25	0,231 (-0,886)	0,812	0,131 (-1,172)	0,879
I29	0,242 (-0,977)	0,835	0,195 (-0,191)	0,576
I30	0,273 (-0,504)	0,692	0,219 (0,281)	0,390
I31	0,411 (0,632)	0,263	0,144 (-1,057)	0,855
I32	0,286 (-0,183)	0,572	0,254 (-0,060)	0,524
I33	0,360 (0,324)	0,372	0,169 (-0,401)	0,656
I34	0,338 (-0,143)	0,556	0,290 (1,335)	0,091
I35	0,451 (1,061)	0,144	0,182 (-0,331)	0,630

As shown in Table 4, Q index values for latent class 1 vary between 0,204 and 0,451. For latent class2, the Q index values range between 0,131 and 0,293. In addition to the Q index values, when the Zq values are examined, it can be said that all items in both classes have non-significant Zq values, that is, in item level model fit to data for both latent classes.

DISCUSSION AND CONCLUSION

This study used MRM to examine differences in TIMSS math success scores. As a result of the analysis, two-class MRM with sizes 0.598 and 0.402 has a better model fit to the data than a standard one-class model for the math test. In general, students in class 2 are more successful than those in class 1 according to their test scores obtained with MRM. Item-level model data fit was assessed via Q and Zq indices, and it was concluded item level model fit was provided. In the study of De Ayala and Santiago (2017), students' mathematical abilities were tested with MixIRT models. Similar to the results of this study, the best model fit is a two-latent class mixture one-parameter model. In addition, some items were found more accessible for one latent class, others harder.

The classes identified in the current study were similar in size but had a different patterns of math achievement. The complex items for both groups are in the “applying” cognitive domain and have constructed response types. The content domain of the more accessible items for students in both classes is “number,” and the cognitive domain regarding these items is “knowing.” When TIMSS 2015 8th grade mathematics questions are examined in terms of a cognitive level conceptual framework, 33% of the questions are at the level of “knowing,” 45% are at the level of “applying,” and 22% are at the level of “reasoning” (Mullis et al., 2016). In other words, it can be said that most of the mathematics questions are based on students' use of problem-solving instead of basic definitions and simple calculations.

The fact that the items that are difficult for both groups are at the applying level can be a valuable finding for the teachers' practices in the classroom and giving homework in the school setting. Teachers can focus on practical situations and real-life problems, which enable students to apply what they know about mathematics in the classroom learning environment. Kazmierzak (1994) stated in his study that practices requiring high-level thinking skills are rarely given by teachers and emphasized that assigning similar problems solved in the course as the practice is ineffective. Incikapı et al. (2016) conducted a study to analyze the cognitive domains of the acquisitions identified in the middle school mathematics curriculum according to grade level (grades five through eight) and content domains with document analysis. It was examined according to the cognitive domains and their sub-domains identified in TIMSS 2015 mathematics framework. As the results of the study, although the distribution of the cognitive domains of the acquisitions differs by the grade levels, for knowing, applying and reasoning, the total number of acquisitions in cognitive areas are very close. In this case, it can be interpreted that the students' difficulties at the applying level might be caused by classroom practices or assessment techniques rather than the curriculum.

In addition, it is necessary to ensure that students are more familiar with the questions they have to construct the answer rather than the multiple-choice ones. For this purpose, measurement and evaluation techniques should be used in which students can construct the answers themselves when they encounter a problem.

There are two sub-groups related to mathematics achievement in the study group because the difficulty levels of the items differ between the classes. Again, there is a significant difference in achievement between the classes. So, two subtypes of strategies exist among students.

Mislevy and Huang (2007) addressed that individuals belonging to different latent classes may be due to different education systems and curricula or the application of different strategies to the solution. A thorough review of item contents can provide beneficial information about the qualitative differences among the examinees. However, in the current study, having access to the actual math items is a limitation. In TIMSS data, only some test specifications like cognitive domains and content areas were provided for the researchers for other minor analyses. That is why deeply examining the contents of items with differing difficulty estimates across latent classes was impossible. Such assessments can provide a more profound comprehension of the development and process involved in math achievement.

Baghaei and Carstensen (2013) stated that MRM has a wide application in developmental psychology. It can be investigated if there are different types of learners with different patterns of learning and if those learner types may be associated with external factors such as age, gender, motivation, first language, etc. For example, as stated by Glück and Spiel (2007, p. 292), considering age differences in item response patterns may be necessary for test development. The Participants at different age levels can reveal unusual processes of change that can contribute to an understanding of development. For this reason, external factors that cause different patterns with MRM applications can be investigated, both confirmatory and exploratory (Baghaei & Carstensen, 2013).

RECOMMENDATIONS

In future studies, in cases where the items are created by the researchers or provided access to full forms of the items, more detailed analyzes can be achieved and more detailed comments can be made about the students' solution strategies. MRM analyses of math tests with well-organized items may answer questions about the nature of math achievement and subgroups of math ability and the relation between these subgroups and other variables.

Declaration of Conflicting Interests

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Statements of publication ethics

I/We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

In this study, TIMSS 2015 8th grade mathematics data, which is open to everyone, was used. Said data was downloaded from https://timssandpirls.bc.edu/timss2015/international-database/ web page. That is, data which is used in the study dated before year of 2020 and open access. Therefore, no ethics committee approval was obtained.

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| Research Article / Araştırma Makalesi |

An Explainable Machine Learning Approach to Predicting and Understanding Dropouts in MOOCs

Açıklanabilir Makine Öğrenmesi Yöntemi ile Kitlesel Açık Çevrimiçi Derslerde Başarısızlığı Tahmin Etme ve Anlama

Erkan Er[1]

Keywords

1. Dropout prediction
2. Explainable machine learning
3. Ai in education
4. Learning analytics
5. Moocs

Anahtar Kelimeler

1. Başarısızlık tahmini
2. Açıklanabilir makine öğrenme
3. Eğitimde yapay zekâ
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Abstract

Purpose: The purpose of this study is to predict dropouts in two runs of the same MOOC using an explainable machine learning approach. With the explainable approach, we aim to enable the interpretation of the black-box predictive models from a pedagogical perspective and to produce actionable insights for related educational interventions. The similarity and the differences in feature importance between the predictive models were also examined.

Design/Methodology/Approach: This is a quantitative study performed on a large public dataset containing activity logs in a MOOC. In total, 21 features were generated and standardized before the analysis. Multi-layer perceptron neural network was used as the black-box machine learning algorithm to build the predictive models. The model performances were evaluated using the accuracy and AUC metrics. SHAP was used to obtain explainable results about the effects of different features on students' success or failure.

Findings: According to the results, the predictive models were quite accurate, showing the capacity of the features generated in capturing student engagement. With the SHAP approach, reasons for dropouts for the whole class, as well as for specific students were identified. While mostly disengagement in assignments and course wares caused dropouts in both course runs, interaction with video (the main teaching component) showed a limited predictive power. In total six features were common strong predictors in both runs, and the remaining four features belonged to only one run. Moreover, using waterfall plots, the reasons for predictions pertaining to two randomly chosen students were explored. The results showed that dropouts might be explained by different predictions for each student, and the variables associated with dropouts might be different than the predictions conducted for the whole course.

Highlights: This study illustrated the use of an explainable machine learning approach called SHAP to interpret the underlying reasons for dropout predictions. Such explainable approaches offer a promising direction for creating timely class-wide interventions as well as for providing personalized support for tailored to specific students. Moreover, this study provides strong evidence that transferring predictive models between different contexts is less like to be successful.

Öz

Çalışmanın amacı: Bu çalışmanın amacı, açıklanabilir bir makine öğrenmesi yaklaşımı kullanarak aynı kitlesel açık çevrimiçi dersin (KAÇD) iki farklı öğretiminde öğrencilerin başarısızlık nedenleri tahmin edilmiştir. Açıklanabilir yaklaşımla, kara kutu tahmin modellerinin pedagojik bir bakış açısıyla yorumlanmasını ve ilgili eğitim müdahaleleri için eyleme dönüştürülebilir içgörüler üretilmesini amaçlanmıştır. Öngörü modelleri arasındaki özellik önemindeki benzerlik ve farklılıklar da incelenmiştir.

Materyal ve Yöntem: Bu araştırma, bir KAÇD'indeki öğrencilerin etkinlik günlüklerini içeren büyük bir genel veri kümesi üzerinde gerçekleştirilen nicel bir çalışmadır. Analizden önce toplam 21 özellik oluşturulmuş ve standardize edilmiştir. Tahmin modelleri oluşturmak için kara kutu makine öğrenme algoritması olarak çok katmanlı algılayıcı sinir ağı kullanılmıştır. Model performansları, doğruluk ve AUC metrikleri kullanılarak değerlendirilmiştir. SHAP, farklı özelliklerin öğrencilerin başarı veya başarısızlıkları üzerindeki etkileri hakkında açıklanabilir sonuçlar elde etmek amacıyla kullanılmıştır.

Bulgular: Sonuçlara göre, tahmine dayalı modeller oldukça yüksek bir performans göstermiştir. Bu da oluşturulan özelliklerin öğrenci katılımını yüksek bir doğruluk payıyla ölçtüğünü göstermektedir. SHAP yaklaşımıyla, tüm sınıfın yanı sıra belirli öğrenciler için dersi neden bıraktıkları otomatik olarak belirlenebilmiştir. Çoğunlukla ödevlere ve ders materyallerine olan ilgisizlik her iki derste de başarısızlığa neden olurken, ana içeriklerin sunulduğu video ile etkileşim sınırlı bir tahmin gücü göstermiştir. Toplamda altı özellik, dersin her iki öğretiminde de belirleyici olmuştur ve geri kalan dört özellik, yalnızca tek öğretimde öne çıkmıştır. Ayrıca, şelale grafikleri kullanılarak, rastgele seçilen iki öğrenciye ilişkin tahminlerin nedenleri araştırılmıştır. Sonuçlar öğrencilerin farklı nedenlerle başarısız olabileceğini göstermiş ve bu nedenlerin tüm sınıf için yapılan analizlere göre farklı olabileceğini ortaya koymuştur.

Önemli Vurgular: Bu çalışma, dersi bırakma tahminlerinin altında yatan nedenleri yorumlamak için SHAP adlı açıklanabilir bir makine öğrenmesi yaklaşımının kullanımını göstermektedir. Bu tür açıklanabilir yaklaşımlar, zamanında sınıf çapında müdahaleler oluşturmak ve ayrıca belirli öğrencilere göre uyarlanmış kişiselleştirilmiş destek sağlamak için önemli bir potansiyele sahiptir. sunar. Ayrıca bu çalışma, tahmine dayalı modellerin farklı bağlamlar arasında aktarılmasının pek mümkün olmadığına dair güçlü kanıtlar sunmaktadır.

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INTRODUCTION

The automatic prediction of at-risk students has been one of the prominent research topics in the learning analytics field (Tseng et al., 2016). Although they existed long before (Roblyer & Marshall, 2002), studies on the use of machine learning to predict at-risk learners have exponentially grown after the emergence of Massive Open Online Courses (MOOCs) around 2011 (Greene et al., 2015; Tseng et al., 2016; Bote-Lorenzo & Gómez-Sánchez, 2018). In MOOC contexts, at-risk learners are usually named as dropouts (Halawa et al., 2014). MOOCs are unique in that thousands of individuals from around the world with different background and motivation participate them online at no cost, which has not been feasible in formal learning settings of higher education. The interactions of MOOC participants during their learning journey create unprecedented amounts of trace data (or digital footprints). The trace data holds huge potential to derive valid engagement metrics and indicators for the prediction of dropouts. These datasets have been very valuable as the accuracy in dropout prediction requires a good quality of indicators (aka, features in machine learning) about a high number of students. Thus, MOOCS have provided, in the last 10 years, a very convenient and competent context for advancing the research on the automatic identification of dropouts (or at-risk learners).

The literature has provided sufficient evidence that with students' online interaction data, machine learning algorithms can accurately predict students who may dropout (Gardner & Brooks, 2018). The primary intervention from dropout predictions has been the early warning systems (Arnold & Pistilli, 2012; Akcapinar et al., 2019). These systems usually contain a dashboard-like interface to somehow visualize students based on their probability to fail (Arnold & Pistilli, 2012). Although the early warning systems provide a viable approach to increasing instructors' awareness about at-risk learners, they are limited in providing explainable and interpretable insights due to the black-box nature of some powerful machine learning algorithms (such as, deep learning and neural networks) (Khosravi et al., 2022). The power of these predictive models in making accurate predictions comes from the advanced mathematical computation required by the behind-the-scenes algorithms. However, this needed complexity makes the interpretation of the results troublesome from the end-user perspective. For example, in the case of dropout prediction, instructors might be provided with a very trustable report about the students with dropout risk; however, such a report without the underlying reasons for the failure limits instructors' ability to intervene properly (Holmes et al., 2021).

Although explainable machine learning and artificial intelligence has been around for several years already (Samek & Müller, 2019), the need for explainable models has been very lately highlighted in the learning analytics literature (Jang et al., 2022; Khosravi et al., 2022). Although there are some initial efforts (Khosravi et al., 2022; Shabaninejad et al., 2022), much more research is needed to explore the potentials of different approaches to creating explainable models in learning analytics. To make a timely contribution to the literature, this study explores the use of an explainable machine learning approach in the context of MOOC dropout prediction. This approach is called SHAP (SHapley Additive exPlanations), which uses Shapley values from game theory (Shapley, 1953) to compute the feature importance in black-box models. The explainable models were applied in two different runs of the same MOOC to explore why students may dropout and also to test the transferability of the findings across contexts. We aim to identify the reasons for predictions provided by a black-box algorithm, and to provide new insights into the ongoing discussion on the transferability of machine learning models across contexts for dropout prediction (Gašević et al., 2016; Er et al., 2020). In this regard, this study addresses the following research questions:

- To what extend the SHAP approach can help explain the predictive power of engagement indicators in the black-box dropout prediction models?
- How do the results regarding the features' contributions to the dropout prediction converge or diverge across two runs of the same course?

BACKGROUND

Dropout prediction in MOOCs

There has been an abundance of research regarding the automatic identification of dropouts in MOOCs (He et al., 2015; Jiang et al., 2014; Crossley et al., 2016; Nagrecha et al., 2017; Bote-Lorenzo & Gómez-Sánchez, 2018; Er et al., 2019). The predictions are usually performed through machine learning models that classify students as at-risks or not based on the features (or indicators) generated from the course engagement data (Sinha et al., 2014). Several factors can affect the performance of machine learning models (i.e., their ability to accurately identify at-risk students). One factor is the quality of the data. A large number of students along with rich data about them is necessary for the effective training of a machine learning model. Poorly trained models are unlikely to produce accurate and reliable results about the target variable or outcome (e.g., dropout or not) (Ye & Biswas, 2014). Associated with this, another important factor is the quality of the predictors and their association with the outcome to be predicted. For example, features that capture relevant aspects of engagement can be more potent to predict if a student is likely to fail or succeed (Veeramachaneni et al., 2014).

The literature has been informative in demonstrating the predictive power of distinct engagement indicators (or features) computed from the clickstream logs. Clickstream logs contain all data about learners' interaction with the MOOC platform (e.g., visiting a page, playing or pausing a video, downloading a file, attempting a quiz, viewing the discussions) (Whitehill et al., 2017). These raw logs offer a rich space to explore for generating features that somehow represent some aspects of student engagement in MOOCs. While the commonly used features in the literature are mostly based on the number of actions performed by learners

such as the number of times a content is visited or a video is watched (Bote-Lorenzo & Gómez-Sánchez, 2018; Er et al., 2020), some other temporal features such as when a lecture was viewed or how early an assignment was submitted were also used as predictors (Ye & Biswas, 2014).

The machine learning algorithms can be categorised into open-box and black-box models. In open-box models, a machine learning algorithm (such as logistic regression) produces results about the predictive power of each feature (in the form of a coefficient); therefore, their results are more interpretable by humans. On the other hand, close-box models uses computationally expensive algorithms (such as, neural network, deep learning) and rather fed with a big sparse data. Although they are found to produce more accurate results (Waheed et al., 2020), the results are less interpretable as they do not generate any information about the predictive power of features. Yet, such information is key to the interpretability of these models, and thus, to their capacity to inform educational decision making. Intervening in an educational context would be more possible and effective if it can be correctly analyzed and interpreted why a student may fail.

Explainable machine learning

An explainable machine learning model differs from a traditional model in that a human can interpret and judge why predictions were made in a certain way (Carvalho et al., 2019). Many models known as black box are optimized for performance rather than interpretability, and it is a challenge to gain insights into how certain features influence the prediction outcome. Some methods have been proposed to extract useful information from these models to increase their interpretability, and these methods promise new opportunities and research directions. Education is one of these domains where explainable black-box models can offer much to unknown underlying reasons for student dropout, while producing very accurate results. A promising approach is to translate black-box machine learning predictions into a format that is interpretable and explainable by the instructors (and any other stakeholders involved) to inform decision-making processes in learning and teaching (Laet et al., 2020).

Some recent research focused on the importance of explainability in learning analytics (Hasib et al., 2022; Shabaninejad et al., 2022; Holmes et al., 2022). While some studies explored the approaches to increasing explainability with dashboards (Shabaninejad et al., 2022), the use of explainable machine learning approaches is still in its infancy in the learning analytics literature (Jang et al., 2022) and more research is needed to explore the potentials of different approaches and methods. Increasing the adoption of such approaches will help open the black box of algorithms for greater interpretability from a pedagogical perspective while still harnessing the computational power of complex algorithms for higher accuracy. In this regard, this study attempts to make a timely contribution to the literature by illustrating the use of SHAP approach for understanding the underlying reasons for dropouts in two runs of the same MOOC.

METHOD

In this section, the methods, data collection tools, data collection process and analysis used for the purposes of your article should be written together with the reasons why they were used. In this section, the methods, data collection tools, data collection process and analysis used for the purposes of your article should be written together with the reasons why they were used. In this section, the methods, data collection tools, data collection process and analysis used for the purposes of your article should be written together with the reasons why they were used.

Data and the feature set

In this study, research data was extracted from a big public dataset[2]. This dataset is composed of millions of logs about student activities in many MOOCs taught via XuetangX (a popular MOOC platform in China) (Feng et al., 2019). For this study, the MOOC titled Introduction to Mao Zedong Thought, was selected (course id is 10610224X) as it contained the largest enrolment. The course lasted four weeks, and each week a new chapter was introduced. Each chapter concluded with an assignment and students were encouraged to share ideas and questions in discussion forums. In the public repository, no other information was provided about the course. In this research, the data pertaining to its two runs were analyzed.

In these MOOCs, students were considered dropout if they did not complete all mandatory activities and stopped visiting the course before all modules were taught. In the test dataset of the first run of the MOOC, there were 351 dropouts from 1087 participants, and in the second run, there were 360 dropouts among 902 participants. The features generated from this data are provided in Table 1. Before the data analysis, all features were standardized.

SHAP: An explainable learning analytics technique

With complex algorithms and a fair amount of data, it is possible to build accurate predictive models. Predictions are more powerful if accompanied with affordances to explain the underlying reasons for a particular outcome (e.g., why a student is expected to drop out). SHAP (SHapley Additive exPlanations) is a technique that adopts a game-theoretic approach (Shapley, 1953) to explain the outcome of predictive machine learning models (Lundberg & Lee, 2017). To increase the model transparency, SHAP

[2] http://moocdata.cn/data/user-activity

computes Shapley values as a measure of the predictive power of the features in a model. In this study, SHAP is used to explain the black-box machine learning models built for predicting dropouts in two runs of the same MOOC.

Python module SHAP is used to provide both global and local interpretability[3]. Here, while global level indicates the predictive analysis involving all participants, local level focuses on specific students as distinct cases when explaining the particular reasons for a selected dropout. SHAP values at global level can illustrate how each predictor feature contributes to the final outcome (i.e., dropout or not), either positively or negatively. At local level, SHAP values are also produced for unique observations, which refer to the individual student records. In this way, while the importance of different engagement indicators can be interpreted at global level, the reasons why a specific student drops out or not can be explained at local level.

Model evaluation and feature selection

Predictive models were built using Multi-layer Perceptron, a neural network algorithm used for the classification tasks (Mitra & Pal, 1995). Particularly, the Scikit-Learn implementation of this algorithm (called MLPClassifer) was used in this study (Pedregosa et al., 2012). Multi-layer perceptron is composed of an input layer, a hidden layer, and an output layer and considered a black-box algorithm since it involves a very complex association between the weights and the function being approximated.

The performance of the predictive models was evaluated using the accuracy and area under the curve (AUC) metrics. These metrics have been the widely used in the literature (Kennedy et al., 2015; Waheed et al., 2020).

Table 1. Features generated from the course log data

Feature category	Feature name	Feature description
Sessions and access to course pages	click_about	Number of times students visited the about page
	click_info	Number of times students visited the info page
	click_progress	Number of times students checked their overall progress
	click_courseware	Number of times students accessed to the system (LMS)
	close_courseware	Number of times students left the system (LMS)
	unique_session_count	Total count of unique sessions per student
	avg_nActions_per_session	Average number of actions per session
Students' engagement in assignments	problem_get	Number of times students open a problem
	problem_check*	Number of times students clicked to check the correctness of their answer
	problem_save	Number of times students saved their current progress on a problem
	problem_check_correct	Number of times the answer was correct for the problem checked
	problem_check_incorrect	Number of times the answer was incorrect for the problem checked
Students' interactions with course vides	load_video	Number of times students loaded a video
	play_video	Number of times students (re)played button in a video
	seek_video	Number of times students sought through a video
	pause_video	Number of times students paused a video
	stop_video	Number of times students stopped a video
Students' discussion form activities	click_forum	Number of times students viewed a discussion forum
	create_thread	Number of times students created a discussion thread
	create_comment	Number of times students posted a discussion comment
	delete_comment	Number of times students deleted a comment

FINDINGS

Model Performances

The neural network models were built and tested for two runs of the MOOC, named as Course #1 and Course #2. According to the results presented in Table 2, the performance of the models was fair, suggesting that the predictive features were considerably associated with the outcome variable. In Course #1, the model performed slightly better.

Table 2. Performance of the prediction models.

Course	Accuracy	AUC
#1	0.80	0.85
#2	0.74	0.81

[3] https://shap.readthedocs.io/en/latest/

According to the models' performances, the features (i.e., engagement indicators) included in the model could effectively estimate student success or failure. To analyse and interpret how these features contributed to the accurate predictions, SHAP values were analysed at global (considering all predictions) and local levels (considering a prediction for a selected student).

Global Interpretability of the Models

At global level, SHAP values were used to identify the important features and explain how they contribute to the final outcome. The results are presented in two sub-sections as follows.

Overall feature importance

The feature importance for Course #1 and Course #2 is visualised in the box plots shown in Figure 1 and Figure 2, respectively. In these plots, the most important 10 features are displayed in a descending order based on the magnitude of their contributions to the prediction accuracy, as determined by the average of the SHAP values (in x-axis).

In Course #1, unique_session_count and click_courseware (which represent the general course engagement) and problem_get and problem_check_correct (which are associated with assignment engagement), have been the features that contributed the most to the prediction. The rest of the features had relatively less importance, which includes two video-related indicators, load_video and pause_video, as well as some other general course engagement (such as click_about, close_courseware). Thus, the number of times the students opened a session in the MOOC platform and their assignment-related activities had a higher predictive capacity than the students' engagement with videos (which are the main teaching content in MOOCs).

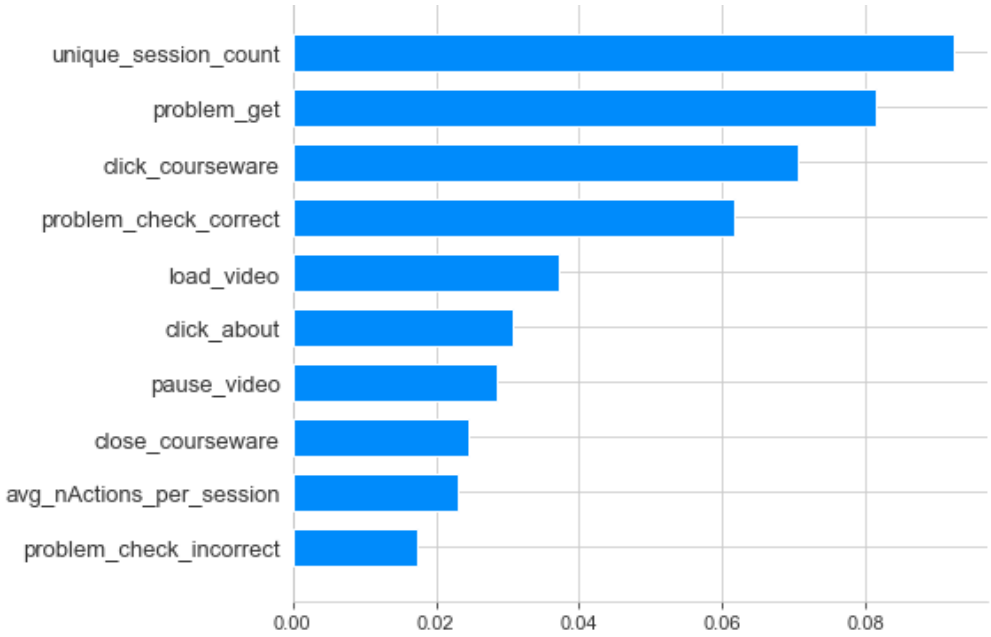

Figure 1. Feature importance in Course #1

The predictive power of the features in Course #2 differs from those in Course #1 as shown in Figure 2, while some similarities are also noted. To begin with, in Course #2, click_courseware played a significant role in predicting students' course outcomes, with a large margin against the rest of the features. Following click_courseware, five other features were influential, containing two features about the assignments (problem_check_correct, and problem_check), one feature about the video engagement (pause_video), and other two features about the general course engagement (click_about, and unique_session_count).

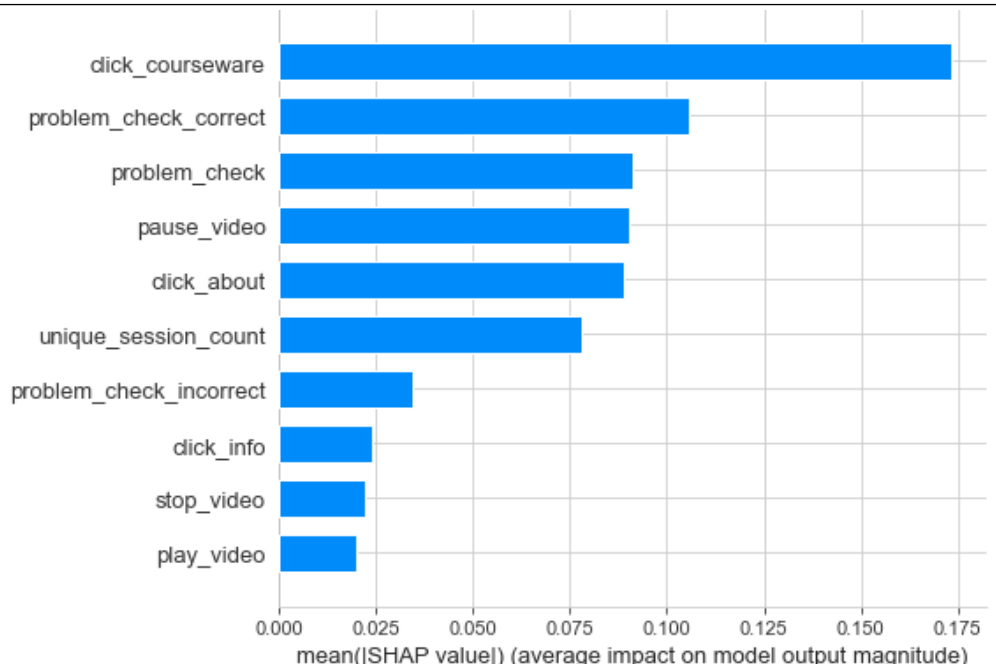

Figure 2. Feature importance in Course #2

Six features were common in both courses, which include unique_session_count, click_courseware, problem_check_correct, click_about, pause_video, and problem_check_incorrect. The remaining four features were found to be strong predictors in only one of the courses. Moreover, in neither of the courses, features about students' discussion form activities were found to be predictive.

The relationships of the features with the predicted outcome

Although the box plots above give information about the importance of all features, they are limited in illustrating their specific associations with the target outcome. For example, solely based on the feature importance, it cannot be known if a greater value in click_courseware is associated with a dropout or success, or vice versa.

SHAP values can be visualized through a summary plot to communicate the positive or negative relationship of the engagement indicators (i.e., predictors) with students' final course outcome (i.e., target variable). The summary plots for Course #1 and Course #2 are depicted in Figures 3 and 4, respectively. In these summary plots, every dot refers to a single student record in the data set, and the colour of a dot differentiates between the succeeded (red) or failed (blue) students. Moreover, in the x-axis, the features are ranked in descending order based on their importance, and in the y-axis, the horizontal location shows the magnitude of the effect of a feature on each student in a positive or negative direction. In the dataset, students who dropped out are labelled as 1 and the others are labelled as 0. For this reason, a positive SHAP value indicates a feature's correlation with dropout, whereas a negative SHAP value is associated with success.

According to Figure 3, in Course #1, all features except click_about hold a negative relationship with the predicted outcome, dropout. That is, when these variables have higher values (denoted by the red dots), students are less likely to drop out (as the blue dots placed on the left hand-side where the SHAP values are negative); whereas as their values increase (denoted by the red dots), the final outcome tends to be a dropout (since the red dots are placed on the right hand-side where the SHAP values are positive). The only feature with a negative relationship with student success is click_about. In other words, students with higher click_about value tended to be those who dropped out the course. In overall in Course #1, higher student engagement, as indicated by almost all important features, contributes to student success.

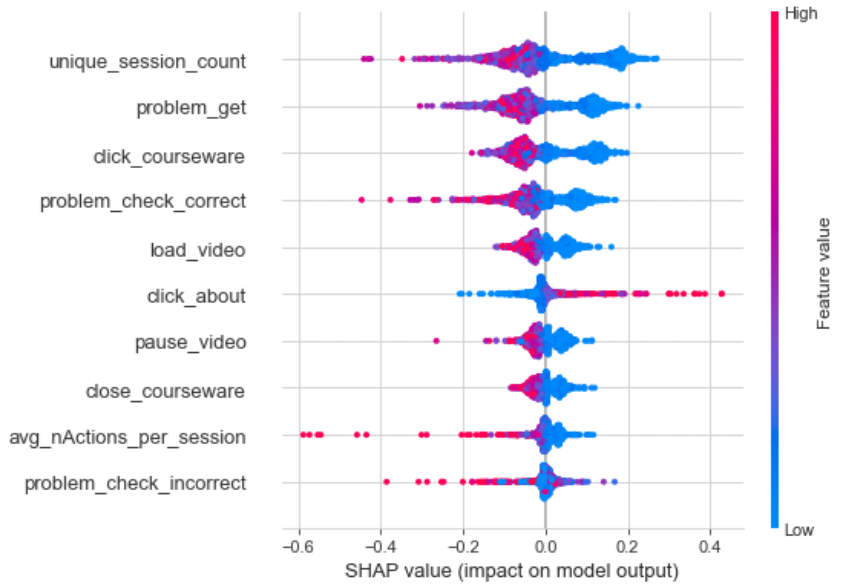

Figure 3. Relationships of the predictors with the target variable in Course #1

As shown in the summary plot in Figure 4, similar results were obtained in Course #2 in terms of the negative relationship between many features and student dropout. In other words, as in Course #1, student disengagement was considerably associated with failure. However, in Course #2, the positive indicators of dropout were different. In particular, high values of problem_check, followed by click_info and play_video, contributed to the prediction of student dropout. None of these features were found to be significant predictors in Course #1. problem_check was the only assignment-related feature with negative relationship with student success. However, its constituting variables (problem_check is the sum of problem_check_correct and problem_check_incorrect) demonstrated a positive relationship with student success. This finding shows that decomposing some indicators can help capture student engagement at deeper level and correctly identify the effects of specific student behavior.

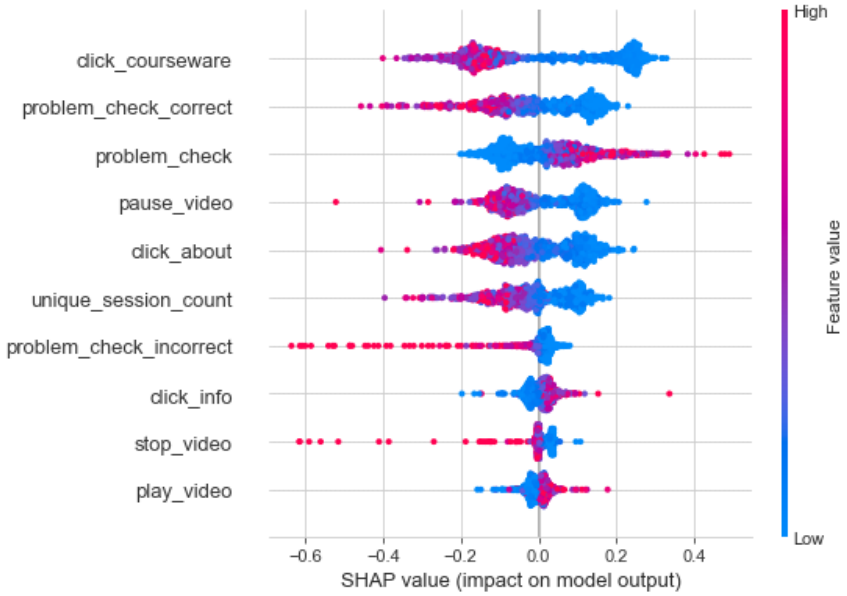

Figure 4. Relationships of the predictors with the target variable in Course #2

Local interpretability of the models

SHAP values can be visualized in several ways to produce explanations for individual predictions. In this way, the possible reasons why a specific student drops out or succeeds can be identified and interpreted. The explanations for specific cases can be different than the prediction trends at the global level.

Waterfall plots are designed to display explanations for an individual prediction based on the SHAP values of all the input features corresponding to that specific prediction. In other words, in this study, a waterfall plot can show why a specific student succeeded or failed in the course given the SHAP values of the features for that student. A waterfall plot starts with a base value at the bottom (which is the average of all observations) and moves toward right with features that pushes the prediction higher (dropout, as shown in red color) or left with the features that pushes the prediction lower (success, as shown in blue color).

In this study, to illustrate how waterfall plots can be effective in explaining reasons for individual predictions, one student was randomly chosen from Course #1 and Course #2, as shown in Figure 5 and Figure 6, respectively. Regarding the first case, most features contributed positively to the success of the student except for two features, namely problem_check_correct and problem_get, which increased students' dropout possibility. In the second case, which is depicted in Figure 6, the high values of problem_check_correct and unique_session_count contributed the most strongly to the student's success, whereas the high value of problem_check was an important indicator of failure for the same student. These results show that local interpretability enables us to focus each student as a different case and understand the possible factors behind a specific student's success or failure.

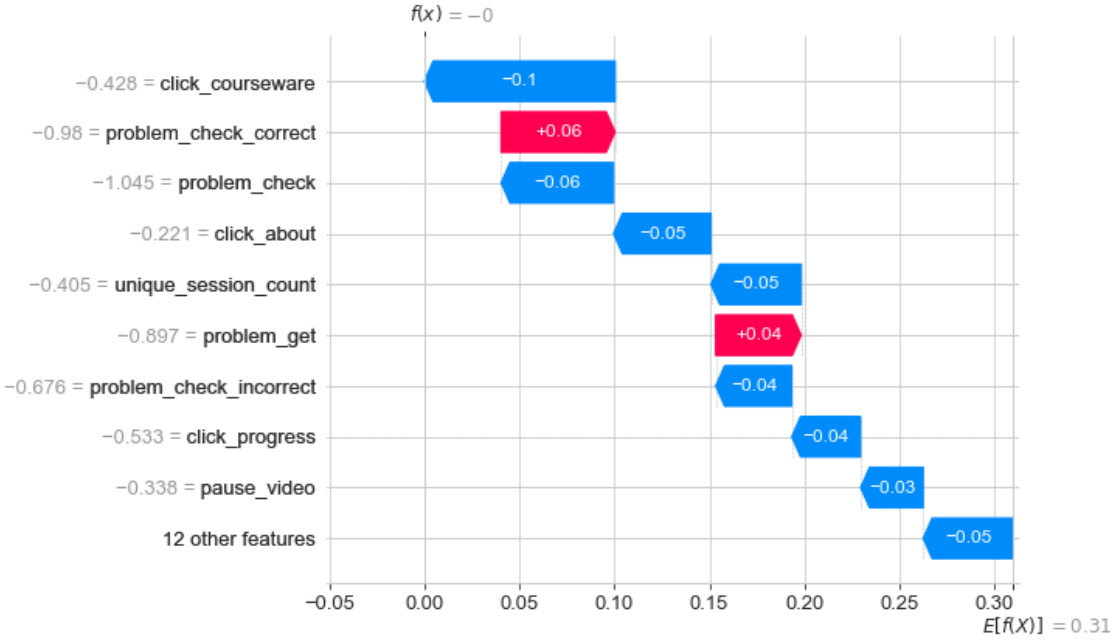

Figure 5. Waterfall plot about a specific student in Course #1

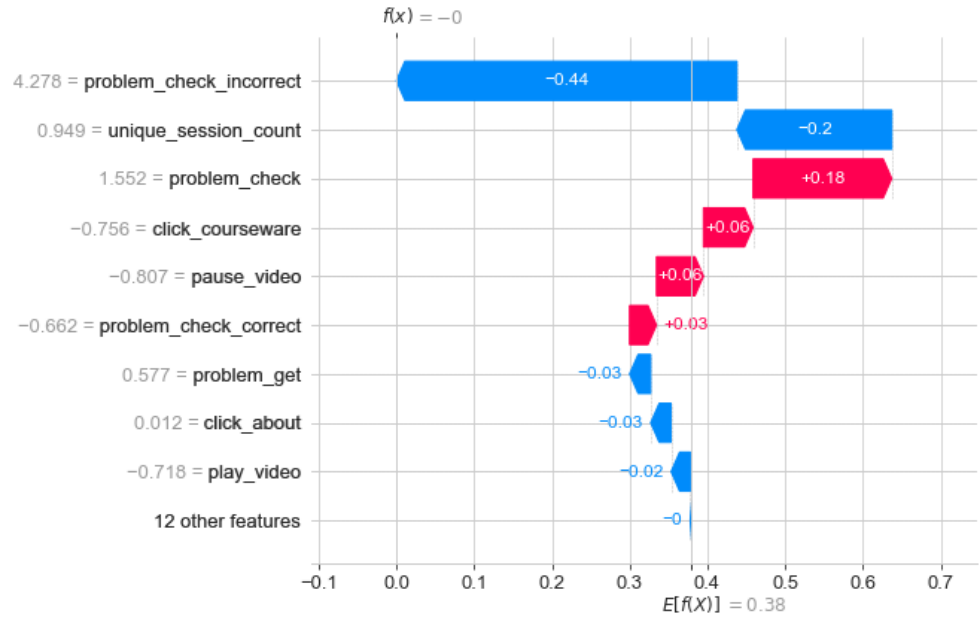

Figure 6. Waterfall plot about a specific student in Course #2

DISCUSSION

The results of this study demonstrate the importance of the use of explainable machine learning approaches in making rich sense of prediction results and provide evidence about the degree to which the same feature set converges or diverges in the two runs of the same MOOC. The discussion of the results and the main findings are presented per each research question as follows.

RQ1. To what extend the SHAP approach can help explain the predictive power of engagement indicators in the black-box dropout prediction models?

The results of this study show that SHAP approach can be effective in opening the black-box prediction models on student dropout. This approach first enabled the analysis of features at global level, averaging the predictions across all students. This analysis reveals the important engagement indicators associated with success, which can provide relevant information for designing interventions to prevent dropout. For example, in the first run of the course, students could be guided to access the MOOC platform regularly (unique_session_count), study the course wares more often (click_courseware), and work on the problems in the system (problem_get). Similarly, in the second run of the course, accessing the course wares was a very strong predictor of student success: students mostly dropped out when the number of times they accessed the course wares was very low. In this case, the instructor could send some reminders to help students regulate their use of the educational materials.

Moreover, in both runs, the frequency of checking answers for the problems (problem_check) solved was negatively associated with success whereas when these frequencies were computed separately for correctly (problem_check_correct) and incorrectly (problem_check_incorrect) solved problems they contributed positively to student success (the contribution of with the largest enrolment was higher). This result may indicate that when students who dropped out tended to quickly try different answers and check its correctness until they find the correct answer, which results in high problem_check value and inconsistencies in problem_check_incorrect and problem_check_incorrect values. On the other hand, other students seemed to reach to the correct answers in a smaller number of trials (i.e., lower problem_check) without inflating the problem_check_incorrect value. An important implication of this finding is that the MOOC platform should limit the number of trials on a problem and make relevant recommendations to the students about the learning materials that they should study (Fazeli et al., 2017). Also, possibly for the next runs of the course, the course instructor could introduce solved example problems as a supplementary guided material to solidify students' learning in difficult topics.

Furthermore, the SHAP approach provided rich intuitions about the reasons why a specific student may fail or succeed, which is not possible with other open-box algorithms such as logistic regression. Although the overall prediction results and the feature interpretations can inform the design class-wide interventions, students' can be provided with more individualized interventions if the particular reasons for their failure could be known. This requires a local-level analysis of the predictions, which is afforded by the SHAP approach. The result of this study revealed that features' SHAP values could change between different students, and they may offer student-specific interpretations of the predictions. Such interpretations could allow instructors to identify why specific students drops out and provide rather personalized support tailored to specific learner needs. That is, explainable machine learning approaches can promote the implementation of personalized education.

RQ2. How do the results regarding the features' contributions to the dropout prediction converge or diverge across two runs of the same course?

Regarding the importance of the features across the two runs of the same course, although a considerably high overlap was noted in the list of the most predictive features, the individual predictive power of each feature varied. For example, in both runs of the MOOC, students' interactions with the problems (e.g., problem_check_correct) and course wares (e.g., click_courseware) played a determining role in their success; however, accessing the course wares was the strongest predictor in the second run while playing a moderate role in the first run of the course. Similarly, the number of sessions in the MOOC platform (unique_session_count), a moderate predictor in the second run, was the feature that contributed the most to the predictions in the first run of the MOOC.

In overall in both courses, indicators about engagement in problems were more powerful predictors of dropout than the indicators regarding students' video activities. This finding indicates that in MOOCs, compared to interacting with lecture videos, student engagement in active learning processes such as working on problems or assignments can be more effective in promoting achievement. Among the video-related features, pause_video was more prominent, suggesting that pausing a video was a good indicator of students' cognitive engagement in the video content, as noted in previous studies (Yoon et al., 2021).

The limited feature overlap between the different runs of the same course highlights the dynamic and complex nature of learning that is affected by many uncontrolled factors. Although the course content might remain untouched, a new learning cohort with different motivations, attitudes, and skills is likely to create a different learning atmosphere, unique peer and teach interactions. All these factors can influence how students engage in a course, which in turn determines their final performance. Therefore, the findings of this study underlines the fact that transferring predictive models between courses (i.e., training a machine learning model in one course and using the trained model in a different course) is quite difficult even for different runs of the same course, and therefore are unlikely to produce very accurate results when different courses are involved. This finding is consistent with some previous research (Gašević et al., 2016; Er et al., 2020). Nevertheless, building predictive models on a big data set involving multiple courses can be useful in determining predictors that can generalize to different courses (Feng et al., 2019).

CONCLUSION AND RECOMMENDATIONS

As we collect more educational data with an increasing depth (rich data about a single learner) and breadth (data about more learners), advance machine learning algorithms comes handy in processing big educational data to obtain accurate results about students who may dropout. However, such algorithms tend to be black box as they do not tell much about the reasons for a specific prediction. This study illustrated the use of an explainable machine learning approach called SHAP to interpret the underlying reasons for dropout predictions at global and local levels. Such explainable approaches offer a promising direction for creating timely class-wide interventions as well as personalised support for specific students.

The major limitation of this study is the lack of detailed description of the context. The data was obtained from a public repository and no detailed information about the MOOC was provided (such as the connection between chapters, the number of videos in each chapter, external resources). A more comprehensive understanding of the context could help better explain why certain features contributed more or less in different runs of the course, and therefore could strengthen the discussion of the findings. A future study can replicate this research in a well-known context to obtain further insights about the effectiveness of explainable machine learning approaches. Moreover, a more comprehensive future research can make a comparison between a black-box and open-box algorithms to investigate the agreement between the explainable approach and the results obtained from an open-box algorithm such as logistic regression or decision tree.

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Statements of publication ethics

I hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported by the corresponding author, who is the only author of this article.

Ethics Committee Approval Information

Since this study was conducted on a publicly available big data accessible via this url: http://moocdata.cn/data/user-activity, ethics committee approval was not required. Besides this available dataset, no additional data was collected.

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| Research Article / Araştırma Makalesi |

Adaptation of Youth Innovational Skills Measurement Tool for Turkish Usage

Gençlere Yönelik İnovasyon Becerileri Ölçme Aracının Türkçe'ye Uyarlanması

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Keywords

1. Innovational Skills
2. Vocational Schools
3. Leadership
4. Proactivity
5. Ingenuity

Anahtar Kelimeler

1. İnovasyon Becerileri
2. Meslek Liseleri
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Abstract

Purpose: The purpose of this study is to adapt Youth Innovation Skills Measurement Tool (YISMT) into Turkish language. The YISMT is a scale developed by Chell (2009) to contribute the improvement of the skills and attitudes which young people need if they are to become the innovators of tomorrow.

Design/Methodology/Approach: This study is a scale adaptation process which was firstly validated through translation and back-translation procedures. Secondly, exploratory and confirmatory factor analyses were conducted to examine its construct validity.

Findings: Factor analyzes results demonstrated that the new scale had 25 items with 6 factors.

Highlights: The Youth Innovation Skills Measurement Tool is an instrument to support the development of the skills and attitudes which young people require if they are to become the innovators of future. This research constitutes the adaptation process of the Youth Innovation Skills Measurement Tool into Turkish, which will contribute to revealing the innovation capacities of vocational and technical high schools.

Öz

Çalışmanın amacı: Bu çalışmanın amacı geleceğin yenilikçileri olacak gençlerin ihtiyaç duyduğu beceri ve tutumların gelişimini desteklemek için Chell (2009) tarafından geliştirilen "Gençlere Yönelik İnovasyon Becerileri Ölçme Aracı'nın" (YISMT) Türkçe'ye uyarlanmasıdır.

Materyal ve Yöntem: Bu bir ölçek uyarlama çalışmasıdır. Buna göre ilk aşamada orijinal ölçek maddeleri Türkçe'ye çevrilerek dil geçerlilik çalışmaları yapılmış, ikinci aşamada ise yapı geçerliğini ölçmek için açımlayıcı ve doğrulayıcı faktör analizleri yapılmıştır.

Bulgular: Faktör Analizi sonuçları, uyarlanan yeni ölçeğin 6 faktörlü 25 maddeye sahip olduğunu göstermiştir.

Önemli Vurgular: Gençlere Yönelik İnovasyon Becerileri Ölçme Aracı, gençlerin yarının yenilikçileri olmaları için ihtiyaç duydukları beceri ve tutumların gelişimini destekleyen bir araçtır. Bu çalışma, mesleki ve teknik liselerin inovasyon kapasitelerini ortaya çıkarmak için katkıda bulunacak olan Gençlere Yönelik İnovasyon Becerileri Ölçme Aracı'nın Türkçe'ye uyarlanma sürecini oluşturmaktadır.

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INTRODUCTION

The world of the 21st century is mainly characterized by an enormous technological development, leading to a new status in the industry: Industry 4.0 (Binner, 2014). The revolution of the industry is of great importance for many countries since it is a systemic change that pertains to a multitude of new technologies with new forms of applications and innovational skills. Thus, industry 4.0 is vital for innovation skills and poses a critical factor in the competition between countries (Pfeiffer, 2015). Accordingly, many countries tend to change their policies to identify the orientation of new industrialization. Those countries' initiatives are renewing the social partnership, developing co-determination, and managing a more vital workplace with skilled employees (Pfeiffer, 2015). Institutions may benefit from employees' innovational skills to produce valuable goods, valuable services and divergent solutions to problems. Besides, innovation is not solely an issue of commercialization of products but also an issue of guiding educational systems. It is seen that commercial companies, innovating organizations and educational institutions are aware of this necessity so that they keep on finding ways to improve innovative skills (Borras & Edquist, 2015).

The rising number of indigent young students in developing countries transpires as a challenge to overcome. Many young people can only find low-quality jobs under unpleasant circumstances with limited options (OECD, 2018). Therefore, work and skills-based education are one of the aims of those countries. They try to accomplish this by updating their education system, fostering an economically, environmentally, and socially sustainable development (OECD, 2018; Tripney et al., 2013). The 21st century business and industry 4.0 necessitate information and innovational skills to be generic and targeted to achieve the favorable outcomes of the education system (Akgunduz & Mesutoglu, 2021; Rowe et al., 2015). Skills for innovation or innovational skills are gained with a qualified education system. This education should involve innovational skills such as technical skills, academic skills, generic skills, soft skills, leadership and digital age literacy (OECD, 2017). For instance, TVET (Technical and Vocational Education Training) system prepares students through a comprehensive education system that supports students and workers' creativity and innovational skills (Fernández, 2020). TVET schools focused on preparing students for work-life; however, although that remains a priority, the education system has shifted its focus to enhancing students' creativity and innovativeness. The focus helps enhance students' employability and increases the chances of establishing businesses and creating employment (Poortman et al., 2011). Innovational skills help students fulfil their aspirations for excellence regardless of gender and provide opportunities in the business environment (Nerstrom, 2017). TVET system offers various school-based and business based environments with the support of those innovational skills. Students both apply their experiences and relate them with their professional knowledge base. Thus, vocational schools' education is pursued with an occupational practice, including technical skills and students' abilities. Students have the chance to combine their different types of knowledge with their profession (Baartman et al., 2018). TVET schools focused on preparing students for work-life; however, although that remains a priority, the education system has shifted its focus to enhancing students' creativity and innovativeness. The focus helps enhance students' employability and increases the chances of establishing businesses and creating employment (Poortman et al., 2011).

Innovation literacy, used as an umbrella term to define innovation concept in education (Sahin et al. (2014), is the ability of students to identify agreeable decisions through processes and work together in a synchronized way with each other by making discussions. Innovation literacy is also the content of comprehending and identifying materials included in innovational phrases and underpins STEM (Science, Technology, Engineering, and Mathematics) (Erdogan et al., 2013). Collaborating, a sense of belonging to a group, and solving problems by accepting the rules also provide innovation literacy (Sahin et al., 2014). A survey conducted by Sutanto (2017) indicates that innovation requires a broad range of skills and showed that innovative employees (those in innovative organizations) use all kinds of skills in their jobs compared to non-innovative counterparts. The innovative skills that distinguish innovation from non-innovative employees include creativity, critical thinking, and the ability to present new ideas (effective communication). Sutanto (2017) also indicates that the education system's role in innovation is defined by subject-based skills, critical thinking, creativity, behavioral and social skills, including self-confidence, collaboration, and persuasion.

The revelation of innovational skills is crucial for training and education systems within the concept of 21st century (Vona & Consoli, 2015). In the 21st century, institutions and teachers need to understand what it takes to improve students' innovational skills. An effective education system is critical to enhancing students' creativity and innovational skills (Dziallas & Blind, 2019). Understanding the factors that contribute to innovational skills, students' innovativeness, and creativity is an essential aspect in determining the student's ability and, therefore, enhancing their innovational ability will be much more easier.

To contribute the needs of having such skills in this century and their development in the education system, this study was conducted to adapt the previously developed (The Youth Innovation Skills Measurement Tool – YISMT) (Chell, 2009) scale to Turkish language and culture in order to find out how young people are regarding their innovative skills. YISMT measures the innovational skills of young learners by aiming to reveal attributes included in the innovation process, which are identifying the innovative capability of young people, searching for ways of finding out this capacity and understanding their innovative behavior.

METHOD/MATERIALS

This study adapted an instrument to identify the generic skills that underpin innovative skills of young people and form a set of attributes clearly linked to the innovation process. To determine the psychometric features of the scale, the latest version of

the scale was applied to the study group and exploratory and confirmatory factor analyses were done to uncover the implicit structure of the scale and to verify the original structure of the scale.

The Model of the Research

First, an initial EFA (Exploratory factor) analysis) was performed to reveal the factor structure of the scale. EFA is a statistical method employed to increase the reliability of the scale by identifying inappropriate items that can be removed and the dimensionality of constructs by examining the existence of relationships between items and factors when the information of the dimensionality is limited (Netemeyer, Bearden & Sharma, 2003). The preliminary analyses demonstrated that the original tools' factor number and the new scales' factor structure did not match. Therefore, a final EFA was conducted to get more reliable results. Finally, CFA (Confirmatory factor analysis) has been performed to verify the factor structure of the scale determined by the 'final EFA', since CFA is a statistical technique frequently used to test whether measurement instruments are consistent with data (Graham, Guthrie, & Thompson, 2003) and to designate how a test might be scored using subscales, i.e. the number of factors is indicative of the number of subscales, the pattern of item-factor relationships (which items load on which factors) indicate how the subscales should be scored (Brown & Moore, 2012).

Participants

In the present study, data obtained in only one round of data collection have been split randomly between the EFA and CFA analyses. In other words, the total of 405 cases with no missing data on the items of the scale was split into two halves randomly. Data were obtained from 405 students in two TVET schools, with the majors included the electric-electronic department, information technologies, machinery technology, furniture department and chemistry department. (Wegener & Fabrigar, 2000). Ozturk and Ficici (2014) state that "When another round of data collection from the same population is difficult, keeping the sample size large in the first round for the purpose of using the data for both EFA and CFA might save time and resources". To cross-validate, the final version of the scale, the two halves of the data served as two separate datasets from two different samples of the same population. In other words, 405 cases with no missing data on the scale items were split randomly, and the two halves were saved as two separate datasets. Therefore, the factor structure was tested and shaped through EFA on one sample (set of 202 cases) by performing a CFA on a second (set of 203 cases) independent sample. In addition that participants' details are given below.

Table 1. Characteristics of the Participants

Department	Grade	N	Percentage
Electric-Electronic	10	72	%17.78
Information Technologies	11	82	%20.25
Machinery Technology	11	109	%26.91
Furniture	12	38	%9.38
Chemistry	11	104	%25.68

Original Scale

The Youth Innovation Skills Measurement Tool aims to address a gap in educational assessment by offering a robust measure of young people's innovational skills. The tool aims to measure five generic skills that underpin innovative behavior and form a set of attributes clearly linked to the innovation: (1) creativity (imagination, connecting ideas, tackling and solving problems, curiosity); (2) self-efficacy (self-belief, self-assurance, self-awareness, feelings of empowerment, social confidence); (3) energy (drive, enthusiasm, motivation, hard work, persistence and commitment); (4) risk-propensity (a combination of risk tolerance and the ability to take calculated risks); and (5) leadership (vision and the ability to mobilize commitment). There were three phases of fieldwork: pilot study; main study part 1 and part 2. The fieldwork comprised students completing an online version of the Tool and focus groups with several staff from a range of disciplines and separate focus groups with a small number of students (usually about seven from a mix of year groups). The last version of the scale after Principal component analysis with varimax rotation included 31 items: 6 for creativity factor, 6 for leadership factor, 7 for energy factor, 8 for self-efficacy factor, and 4 for risk-propensity factor.

Language Adaptation Process

After authorization from the author of the original YISMT, a Turkish version of the scale was developed, using the process of forwarding translation (Acquardo et al., 2004). Accordingly, there were five steps of the translation method which were applied: (1) translation of the original instrument into the target language, (2) comparison of the three translated versions of the instrument, (3) backward translation or blind double translation of the preliminary initial translated version of the instrument, (4) comparison of the back-translated versions of the scale, and (5) adapting the new Turkish scale into the Turkish language. The process of forwarding translation consisted of an initial preparation of two translations, completed by three independent Turkish bilingual translators: (1) a professional translator with 15 years of experience, (2) a PhD student and teacher of English and (3) a professor in Educational Technology field. Then, a consensus version was prepared by three of the authors. This consensus version was then back translated by two English translators, one of whom was a senior fellow English teacher with 18 years of experience, and the other was a PhD student and teacher of English Language Sciences with eight years of experience. The back 40 translated version was evaluated to verify agreement with the original instrument, and then a final version of the new scale was constructed. After the process of translation, the Turkish version of the scale was controlled by an experienced Turkish Language instructor with 20 years of experience and a Turkish language teacher with 5 years of experience. Turkish instructors had paid more attention while translating the reverse coded items since even a word should cause misunderstandings.

FINDINGS

Initial EFA

In the present study, an EFA was conducted on the 51 items, including dependent variables with 202 TVET school students. A Promax rotation using SPSS was applied for this initial EFA. Tabackhnick & Fidell (2007) declares that the best way to decide between orthogonal and oblique rotation is to conduct oblique rotation [e.g., direct Oblimin or Promax from SPSS] with the desired number of factors and check the correlations among factors If the data do not drive factor correlations, the solution remains nearly orthogonal. If correlations exceed .32, then there is a 10% (or more) overlap in variance among factors, enough variance to warrant oblique rotation unless there are compelling reasons for orthogonal rotation (Tabachnick & Fidell, 2007). Additionally, Fabrigar et al. (2000) recommend that, even when the correlations among components are negligibly low, researchers should run an oblique rotation, an oblique (Promax with a Kappa of 4) rotation was applied. In the present study, the internal consistency reliability coefficients (Cronbach's alphas) were calculated for each component, using the item scores of the items measuring each component. At the first step, using the 'eigenvalue more significant than one' criterion and an oblique (Promax) rotation, the analysis with 51 items generated eleven components should explain 60% of the total variance. Then, each item was assessed in terms of the following criteria: (1) whether it has a loading of greater than or equal to 0.35 on the dimension it is intended to measure while having no loadings of greater than or equal to 0.35 on other dimensions (as an indicator of simple structure); (2) whether there are at least two other items that measure the same dimension and meet the first criterion (as an indicator of strength and stability of extracted components) (Costello and Osborne, 2005). The four items which did not meet the criteria were eliminated. Prior to the extraction of the factors, Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity tests should be used to assess the suitability of the respondent data for factor analysis. The KMO index, in particular, is recommended when the cases to variable ratio are less than 1:5. While the KMO index ranges from 0 to 1, with 0.50 considered suitable for factor analysis, Bartlett's Test of Sphericity should be significant ($p < .05$) (Tabachnick, 2007). Cumulative percentage of variance (criterion) is another area of disagreement in the factor analysis approach (Williams et al., 2010). Accordingly, Bartlett's Test of Sphericity (4448,15, $p = 0.000$) and Kaiser-Meyer-Olkin (KMO = 0,85) was found acceptable (Kaiser, 1974).

Finally, 51-item structure explained 46% of the variance in the pattern of relationships among the items. According to the factor pattern matrix, which indicates the independent relationship between each measure and the factors, items with less value than 0.10, are dropped from the scale (Wood et al., 1996). In the end, four factors and 30 items remained (the first factor had 16, the second factor had 7, the third factor had 4, and the last factor had 3 questions).

According to correlation matrix results, it should be observed that some elements were not zero to the first decimal place (approximately 7%). Thus, one may interpret this as sufficient evidence that the matrix is close to diagonal, thereby deciding that the data are good for factoring (Charles, 1974). The preliminary analyses demonstrated that the original tools' factor number and the new scales' factor structure did not match. When the pattern matrix was analyzed, it was seen that there had been a unidimensional factor structure due to 13 reverse code items and the 3 items with low reliability. In accordance with the results of the factor structure, it was decided that reversed items often led to problems, the inferior model fit of factor models (e.g., Marsh, 1988). In some cases, the problem is not simply that the model is inadequate based on the hypothesized initially substantive factor structure. The lack of fit stimulates the revision of a more parsimonious conceptualization and the specification of additional substantive factors. The technique of interspersing positive and negative questionnaire items has been debated in the survey methodology literature for over fifty years to prevent response bias. The authors argue the usage of reversed items in measurement instruments, and they add that they should be used with caution, if necessary. They draw attention to the reversed items' measurement problems, such as low measure reliability complex factor structures. (Weijters & Baumgartner, 2012). These problems may be seen in some research studies. For instance, the results of the Rasch fit statistics and the confirmatory factor analysis suggest that the reverse directional items differ in psychometric properties from the straightforward items (Cronbach, 1942, 1950, as cited in Billiet & McClendon, 2000). Favorable to negative transformations change an item's psychometric

characteristics and, more importantly, change the construct that an item is intended to measure (Benson & Hocevar, 1985). Harvey, Billings and Nilan (1985) declared that with reverse coded items, it is impossible to know whether a test person understood the question correctly or whether the person missed the reversing of the scale and just used the scale as before. Unfortunately, research has shown that reverse-coded items may produce artefactual response factors consisting of negatively worded items (Benson and Hocevar 1985; Harvey et al., 1985; Herche and Engelland 1996; Pilotte and Gable 1990). The negative wording factor of the scales could represent something more than a response artefact, that is, complex substantive multi-dimensionality that should be investigated in-depth (Arias, 2017). Also, it is easy for respondents to misinterpret phrases that include negation, e.g., being not unhappy does not mean that one is happy (see Swain et al., 2008, for some recent evidence) (Weijters, 2013). Disturbingly, even low rates of misresponse can cause problems in basic analyses. Through simulation, Schmitt and Stults (1985) demonstrate that when mis-response is as low as 10%, factor analysis produces a two-factor solution in translations of instruments, even if a single factor exists in the population. (Scott et al. 2008). Researchers who employ mixed-worded scales often find that reverse worded items display somewhat lower reliability and weaker item-to-total correlations than their positive-worded counterparts (Cronbach 1942; Benson and Hocevar 1985; Peabody 1966). A positively prepared questionnaire shows higher Cronbach's alpha coefficient values and a better theoretical factor structure (Salazar & Bernabe, 2015). Data collected through multi-item Likert scales that contain reversed items often exhibit problems, such as unexpected factor structures and diminished scale reliabilities. These problems arise when respondents select responses on the same side of the scale neutral point for both reversed and non-reversed items, a phenomenon the authors call "misresponse." (Scott et.al., 2008).

Final EFA

Considering the literature review and preliminary EFA with reverse worded items, a new EFA with ProMax was conducted by excluding 16 items which had caused low reliable results in the preliminary factor analysis. According to results, Bartlett's Test of Sphericity (3102.430, p = 0.000) and Kaiser-Meyer-Olkin (KMO=0,89) were in acceptable value interval (Kaiser, 1974). Finally, this 51-item structure explained 51.278% of the variance (which is a higher percentage from the initial EFA) in the pattern of relationships among the items. The cumulative percentage was nearer to %60, which was aligned with literature (Costello & Osborne, 2015). Pattern matrix demonstrated six factors and 25 items considering the dimension of %35 (Costello & Osborne, 2005). With a sample size of 100 participants, loadings of .30 or higher can be considered significant or at least salient (see discussion in Kline, 2002, pp. 52-53). With much larger samples, even smaller loadings could be considered salient, but in language research, researchers typically take note of loadings of .30 or higher. Variables with loadings of. 30 or higher on more than one factor should be considered (Corner, 2009). In this research, while analyzing the correlation matrix, the matrix was close enough to diagonal, thereby deciding that the data are good for factoring, which should be observed some elements were not zero to the first decimal place (approximately 7%) (Charles, 1974). To sum up, the factor loading values for this current study are observed as being of a high level as seen in Table 2.

Table 2. Factors Resulting from the Final EFA and the Factor Loading Values

	Factors					
Items	1	2	3	4	5	6
s4	.734					
s10	.602					
s13	.614					
s41	.479					
s51		.403				
s53		.439				
s54		.541				
s55		.587				
s56		.676				
s57		.580				
s58		.446				
s24			.467			
s30			.546			
s37			.583			
s8				.610		
s42				.681		
s48				.422		
s1					.588	
s23					.738	
s29					.576	
s47					.395	
2						.575
18						.459
39						.373
52						.494

CFA Results

CFA which is a type of structural equation modeling (SEM) that can measure the relationship between observed and latent variables, was used in the study to validate a specific scale (Brown, 2006). It provides whether the scale fits in to the model and each goodness of fit index has certain critical limit points. Such as, correlation coefficient between factors and goodness of fit values should be less than 0.85. In addition, factor loadings should be high, error variances should be low and items' explanatory (R2) values should be high (Kline, 2005; Çokluk and fri., 2010). Besides, Awang (2015), suggests that factor loadings should not be lower than 0.50. Most of the fit measures will have a value of “0” since this is the worst model possible, whether parsimony-adjusted or not. In rare occasions, some fit indices, such as RMSEA and GFI, may have a non-zero value depending on the data (Schermelleh-Engel, K., et.al., 2003).If the results of the EFA model fit poorly, the model is rejected. CFA was conducted in this study to determine whether the scale factors were compatible with the data collected on a different sample to determine the accuracy of the construct validity. Goodness of fit criteria after confirmatory factor analysis are given in Table 3. In addition that, the final version of the scale is in the appendix.

Table 3. CFA Indexes of the Scale

Index	Normal Value	Acceptable Value	Scale
χ2/df	<2	<5	1,983
GFI	>0.95	>0.90	,906
AGFI	>0.95	>0.90	,899
CFI	>0.95	>0.90	,912
RMSEA	<0.05	<0.08	,046
RMR	<0.05	<0.08	,039

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This study is the adaptation of YISMT developed by Chell (2009) into Turkish language. The original scale included 6 factors and the adapted scale had also 6 factors. The results of the CFA show that the fit statistics calculated by confirmatory factor analysis were in agreement with the actual data collected from the participants in an acceptable level. This indicates that the scale was in good agreement with the factor structure previously determined. When the standardized coefficients were examined, it was found that factor loadings were high, standard error values were low, t values were significant ($p < 0.001$) and R2 values were high. These results confirm the construct validity of the predetermined factor structure.

After the translation process, the results demonstrated that the new scale (Innovativeness Scale of Young Learners) had 25 items with six factors which were renamed as Leadership (has the same items with original scale except for 4th and 10th items), Energy (51st and 58th are the same), Braveness (24th and 30th items are the same with original scale), Proactivity (all of the items are the same with original scale), Ingenuity (all of the items are the same with the original scale), self-efficacy (all of the items are the same with the original scale).

The results of the analyses show that the fit statistics calculated by confirmatory factor analysis were in agreement with the actual data collected from the participants in an acceptable level. This indicates that the scale was in good agreement with the factor structure previously determined.

In conclusion, based on the analyses conducted, it can be asserted that the new scale is a valid and reliable assessment instrument in the Turkish language. Researchers may apply this scale in other fields dealing with innovational skills. In addition, a similar study on the innovational skills of students may be conducted on a different sample group.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Examples of author contribution statements

Hilal Zeynep Altınışık and Tufan Adıgüzel conceived of the presented idea Hilal Zeynep Altınışık developed the theory and performed the computations. Hilal Zeynep Altınışık and Tufan Adıgüzel verified the analytical methods. Hilal Zeynep Altınışık encouraged Yasin Gencer to investigate and supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

As of 2020, researchers applying are required to upload the Ethics Committee Approval Document. Such information as institution name, date, number, etc. regarding the "Ethics Committee Approval Document" should be presented here.

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APPENDIX

Öğrencilerin İnovasyon Becerileri

Aşağıdaki ifadelere ne düzeyde katıldığınızı lütfen belirtiniz.

		Kesinlikle	Katılmıyorum	Kısmen	Kararsızım	Biraz	Katılıyorum	Kesinlikle
1.	Arkadaşlarım onları temsil etmem için hep beni seçerler.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.	Sınıfta yeni fikirlere ihtiyaç olduğunda arkadaşlarım bana danışırlar.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.	Takım lideri veya başkan olarak genelde hep ben seçilirim.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
4.	Proje çalışmaları grup içerisinde liderlik rolü üstlenmem için bana fırsat tanır.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
5.	Birçok işi aynı anda yürütmeyi severim.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
6.	Yeni fikirler üretmekte üstüme yoktur.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
7.	İnsanlara çekinmeden ne yapmaları gerektiğini söylerim.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
8.	Öyle zamanlar oluyor ki önerdiğim fikirler hem başkalarını hem de beni şaşırtıyor.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
9.	Kendimi risk alan bir kişi olarak tanımlarım.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
10.	Benden istenilen bir şeyi yapma konusunda kendime güvenirim.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
11.	İstediğim şeyler için sabır eder ve sonunda elde ederim	(1)	(2)	(3)	(4)	(5)	(6)	(7)
12.	Takdir edilmek, daha sıkı çalışmamı sağlar.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
13.	Bir şeyin nasıl yapılacağını öğrenmek için çaba harcadıkça yapabileceğime olan inancım artar.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
14.	Kendimi ifade etme fırsatı vermeyen konuları sevmem.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
15.	Verilen zor işlerin üstesinden gelmeyi severim.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
16.	Beni zorlayacak işleri severim.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
17.	Bir işi yaparken arkadaşlarım vazgeçse bile ben gerekeni yaparım.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
18.	Bir grubun lideri olmayı severim.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
19.	İnsanların beni lider olarak benimsemesini sağlamak beni mutlu eder.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
20.	İnsanları belli bir iş için bir araya getirip yönetmek hoşuma gider.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
21.	Grup çalışmalarında genelde başkaları adına karar alma sorumluluğunu ben üstüme alırım.	(1)	(2)	(3)	(4)	(5)	(6)	(7)

22.	İşleri tamamlamaktan zevk alırım.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
23.	Bir şeyleri iyi yapmaktan mutlu olurum.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
24.	Kendime güvenimin tam olduğunu söylerler.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
25.	Kendimden emin bir insanımdır.	(1)	(2)	(3)	(4)	(5)	(6)	(7)