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CONTENTS Page

Research Articles

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*The article titled "Educational Research and Development Policies and Institutional Structures of Turkish Educational System" was simultaneously uploaded and published in a different journal with the title "Teacher Perceptions and Expectations Regarding Research and Development in Education (R&D) Studies". The boards of both journals have decided to mutually remove these articles from their contents for the following reasons:
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•The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).

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Investigating the Mediation Effect of 21st Century Skills between Teachers' Decision Making Styles and Professional Autonomy*

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Abstract

This correlational research design study aims to examine the mediation role of 21st century skill between teachers' decision making styles and their professional autonomy, based on the theoretical framework. The population of this study consists of 910 teachers working in the Nazilli district of Aydın province in the 2021-2022 academic year. In the study, the maximum diversity sampling method was used and responses were received from 435 teachers through 'Personal Information Form', 'Multidimensional 21st Century Skills Scale', 'Teacher Autonomy Scale' and 'Decision Making Styles Scale'. Inferential statistical calculations were made and construct validity and mediation tests were conducted. As a result, it was seen that the direct effect of teachers' decision making styles on their professional autonomy was 0.55; when 21st century skills were included in the model as a mediation variable, this effect decreased to 0.40 and this value was still statistically significant. In this respect, it was determined that there was a partial mediation role between teachers' 21st century skills, decision making styles, and professional autonomy. In addition, the Sobel Z test was applied to examine the mediation role and it was determined that the mediation effect was statistically significant ($z=3.91$; $p<.05$). In light of these findings, the fact that the effect of decision making style decreased after 21st century skills were added to the model, but this effect was still significant, showed that 21st century skills were a partial mediation variable in this relationship. Teachers with the high 21st century skill were found to be able to act professionally autonomous enough in decision making situations. It is expected that determining the direction and roles of the relationship between these variables and presenting them as a model will contribute to the literature, serve as a source for teachers and researchers, and provide inspiration for new studies.

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* The article was produced from a part of the data from the first author's master's thesis titled "The relationship between teachers' decision making styles and professional autonomy behaviors within the scope of 21st century skills.

INTRODUCTION

The world is rapidly changing, creating to new situations in all areas of life. As a result of the reflections of these changes in science, education has been also evolving according to the needs (Alkış, 2020). The skills that individuals need to acquire from these developments have been also diversifying. With the cumulative and innovative advancement of education, skills suitable for the 21st century have been emerging, creating a new need (Kırgız, 2019). Ekici et al. (2017) listed the most common skills among the 19 skills that will be necessary for this era as problem solving, communication, collaboration, creativity and innovation, critical thinking, decision making, information, technology, media literacy, responsibility, leadership, productivity, flexibility and adaptability, entrepreneurship.

According to the Partnership for 21st Century Skills, these skills consist of learning and innovation; information, media, and technology; life and career (P21, 2019). Learning and innovation skills encompass creativity and innovation, critical thinking and problem solving, communication and collaboration; they are defined as the ability to analyze and separate information, draw conclusions, interpret results, generate products, and adapt to teamwork and work-life. Information, media, and technology skills involve effectively using information, media, and technology and analyzing and evaluating the information; they include skills in information literacy, media literacy, and ICT (Information, Communication, and Technology) literacy. Life and career skills encompass flexibility and adaptability to excel in the globally competitive business world, coping with the complexities of life and work, and building a career by utilizing effective communication skills; they include skills in flexibility and adaptability, initiative and self-direction, social and cross-cultural interaction, productivity and accountability, and leadership and responsibility (P21, 2019). Çevik and Şentürk (2019) compiled the categories from institutions, organizations, and individuals (APEC, 2008; ATC 21, 2015; ISTE, 2007; AASL, 2009; Hixson, Ravitz & Whisman, 2012; Johnson, 2009; National Research Council, 2011; NCREL, 2003; OECD, 2018; P21, 2019; Wagner, 2012) and examined the multidimensional 21st century skills for young adult groups as 'information and technology literacy', 'critical thinking and problem-solving', 'entrepreneurship and innovation', 'social responsibility and leadership skills', 'career awareness'. According to Çevik and Şentürk (2019), these skills encompass learning and renewal, critical thinking and creative problem-solving, communication and collaboration, information, media and technology literacy, social responsibility, intercultural awareness, effective decision making, self-management, entrepreneurship and change-transformation leadership, and career awareness skills.

The goal of the 21st century education is to raise generations, acquiring complex problem solving, effective communication, critical thinking, collaboration, and the ability to compete on an international scale while forming their own national identity and consciousness (GDoTT, 2017). At this point, the alignment of teachers, being the conveyors of these skills, with 21st century skills become crucial. It is expected that teachers should possess the skills, desired to be developed in students and society as a whole (Voogt et al., 2013). Therefore, there is a need for teachers, embracing 21st century skills and making efforts to transfer them to students (Yavuz, Özkaral & Yıldız, 2015). Reports as 'Contemporary Teacher Profile Needed by the Turkish Education System as We Enter the 21st Century' (DoERD, 2001), 'MoTNE 21st Century Student Profile' (DoERD, 2011), and '21st Century Skills and the Quality of Education Meeting Series' (TIBA [Turkish Industrialists' and Businessmen's Association], 2012), as well as organizations as the P21 Framework, OECD, ATC21S, NETS/ISTE, highlight certain skills (Dede, 2009; Voogt & Roblin, 2010). Among these notable skills are life and career, ways of thinking, professional autonomy, and decision making skills. The WEF (2016) reported on skills, workforce, and employment strategies in 'The Future of Jobs'. They identified the top 10 skills comparatively for 2015-2020, with critical thinking and decision making skills included in each year (Soffel, 2016). Particularly in today's fast-paced environment, where quick and effective decisions need to be made, the abundance of information makes the decision making process challenging in finding qualitative

information among quantitative data (Çelik, 2021). Therefore, the decision making skill, included in the scope of 21st century skills, holds an important position among the skills individuals need to acquire (AACU, 2007; ISTE, 2007).

In the 21st century, the quantity and quality of decisions by teachers, taking on a fundamental role in educational practices (Sünbül, 2011), vary based on individual characteristics and skills, social and cultural factors, values, and the type of problem situation (Çolakkadıoğlu & Güçray, 2007). The experience of different processes in the same decision situations is explained by decision making styles (Nutt, 1990). Decision making styles are defined as the predisposition or habit of providing similar responses to a problem rather than being a personality trait (Scott & Bruce, 1995). Styles, arising from personal differences, cannot be categorized as good or bad; individuals tend to adopt the style that best suits their qualities at certain times or situations (Dinçer & Saracaloğlu, 2011).

Scott and Bruce (1995) define five styles of decision making 'rational decision making style', 'intuitive decision making style', 'dependent decision making style', 'avoidant decision making style', and 'spontaneous decision making style'. The rational decision making style involves a careful approach where the decision making process is logically conducted. The intuitive decision making style encompasses the use of emotions and instincts by the decision maker to reach a decision. The dependent decision making style is characterized by decision makers being influenced by guidance and advice from trusted individuals. The avoidant decision making style involves decision makers trying to avoid taking responsibility by distancing themselves from the decision. The spontaneous decision making style entails decision makers making decisions based on the current situation, choosing a solution option they feel close to, and making the decision suddenly and effortlessly (Scott & Bruce, 1995).

Understanding the world today, the role of teachers has shifted towards being individuals, creating their own materials, methods, classroom activities, and handle every aspect related to teaching, rather than just accepting and implementing predetermined content, curriculum, and methods set by others (Nunan, 2004). The changing role of teachers evokes the concept of 'autonomy'. Teacher autonomy, to define the scope of teachers' authority in the education system (Öztürk, 2011), is considered one of the factors determining the quality of education in PISA studies by OECD (Ayral et al., 2014) and has gained considerable attention in recent international conferences and researches (Ramos, 2006). Teacher autonomy encompasses the preparation and implementation of curriculum, the selection of textbooks, and the monitoring of these processes (Çolak, 2016). Furthermore, autonomy is associated with the organization of work environments, participation in management processes, and decision making authority related to these matters (Ayral et al., 2014). Underlying the display of autonomous behaviours by a teacher is their competence and genuine dedication to the profession. The professional autonomy of a teacher, which distinguishes them in terms of being 'assigned' or 'dedicated', lies in their willingness to take a stand for the quality of education and the success of their students. The teacher's dedicated commitment to their profession brings them closer to professionalism (Erol, 2022).

Çolak (2016) categorizes teacher autonomy into four groups 'curriculum autonomy', 'teaching process autonomy', 'professional communication autonomy', and 'professional development autonomy'. Curriculum autonomy encompasses making decisions to meet student needs and stimulate their interest by balancing the preparation of content, complying with the standard structure, expanding and deepening the program (Ormond, 2017). Teaching process autonomy includes making independent decisions regarding feedback, assessments, grading, rewards, books, materials, contents, assignments, time management, methods and techniques, communication language, and classroom and disciplinary rules (Çolak, 2016; Oberfield, 2016). Professional communication autonomy refers to the freedom of teachers in their dialogues with colleagues, students, parents, and administrators (MoTNE, 2015). Professional development autonomy entails

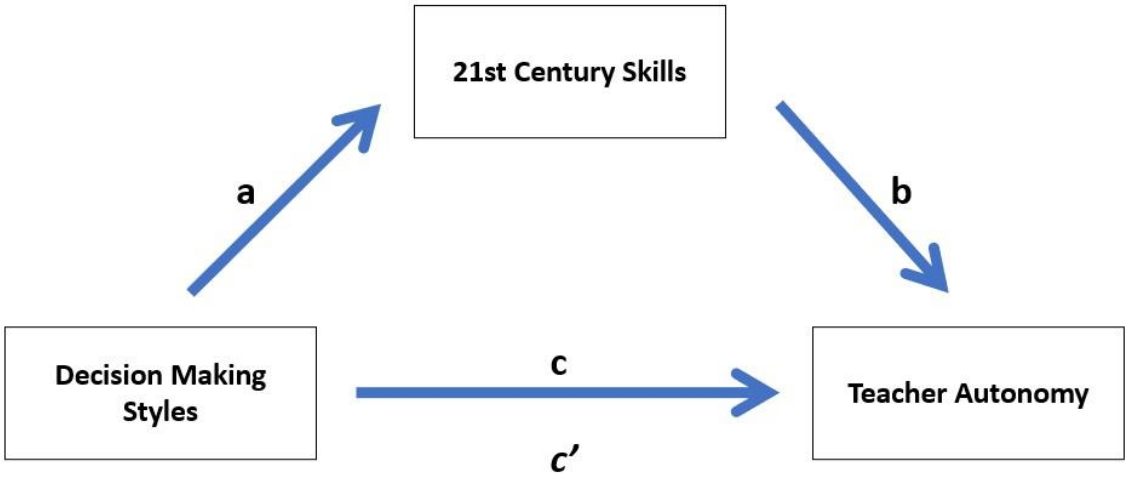
teachers making autonomous decisions to participate in in-service training, scientific activities, and activities aimed at self-improvement (Üzüm, 2014).

The general framework and rationale of the study revolve around establishing a relationship between teachers' decision making skills, which are considered 21st century skills, and professional autonomy, which is also recognized as a 21st century skill. Based on the statements and findings in the literature, it can be inferred that decision making styles predict professional autonomy and 21st century skills. Therefore, it is deemed appropriate to define the ways in which decision making styles and 21st century skills impact teachers' autonomy. Theoretical studies by Ayral et al. (2014), Bieg, Backes, and Mittag (2011), Crawford (2001), Çelik (2016), Çolak (2016), Ertürk (2020), O'Hara (2006), Ormond (2017), Rudolp (2006), and Üzüm (2014) support the prevailing view that decision making skills have an impact on teacher autonomy as a whole. Considering that one of the variables in the study, teacher autonomy, conceptually encompasses the decision making process in its definitions and sub-dimensions, it is anticipated that a path from decision making styles influenced by 21st century skills to teacher autonomy can be identified. Furthermore, previous research in the field has identified 21st century skills as a variable that also influences teacher autonomy. Consequently, in this study, decision making styles are considered the independent variable, teacher autonomy the dependent variable, and 21st century skills the mediating variable, and the theoretical structure of the research is defined (Figure 1). Exploring the relationships between decision making styles, teacher autonomy, and 21st century skills is of great importance for teachers to fulfill their professional roles. Examining the direct and indirect relationships between these variables will determine the extent to which decision making styles and 21st century skills affect the concept of teacher autonomy.

There are studies, examining the direct impact of decision making styles on teacher autonomy in the literature (Bozkurt & Kara, 2022; Ertürk, 2020; Maviş-Sevim, 2020; Öztürk, 2011; Ulaş & Aksu, 2015). However, there is a lack of research findings on how decision making styles, through 21st century skills, affect teacher autonomy. National and international reports as PISA, OECD, and DoERD emphasize the importance of teachers' 21st century skills. This necessitates the identification of teachers' 21st century skills, the development of these skills, and the creation of a model, influencing the development of 21st century skills. In line with the decision making skills among these skills, it is anticipated that this research on how teachers' decision making styles change to what extent with the development of 21st century skills and subsequently teacher autonomy would contribute to the field of teacher education by providing valuable insights and sources. It is expected that further research on the direct and indirect relationships between decision making styles, 21st century skills, and teacher autonomy will provide more evidence in the literature and create opportunities for the establishment of new theoretical models involving similar or different variables that influence the development of 21st century skills.

This study aims to test the indirect effect of teachers' decision making styles on their professional autonomy and the mediating role of 21st century skill, based on a theoretical framework. Due to the multidimensional nature of the measurement tools, both direct and indirect effects, along with the sub-dimensions of the scales, have been examined. The theoretical model, shown in Figure 1, depicts the direct relationships between variables through paths a, b, and c; the indirect relationship between variables by *c'*. (Aksu, 2012).

Figure 1. *Theoretical Model of Variables*



According to Baron and Kenny (1986), to establish the mediating effect of '21st century skills' when examining the prediction of 'professional autonomy' as the dependent variable by the independent variable of 'decision making styles', four conditions must be met (Baron & Kenny, 1986, as cited in Şimşek, 2020). In line with this, the hypotheses of the study are formulated as follows:

H1: There is a significant and positive relationship between teachers' decision making styles and teachers' professional autonomy.

H2: There is a significant and positive relationship between teachers' decision making styles and teachers' 21st century skills.

H3: There is a significant and positive relationship between teachers' 21st century skills and teachers' professional autonomy.

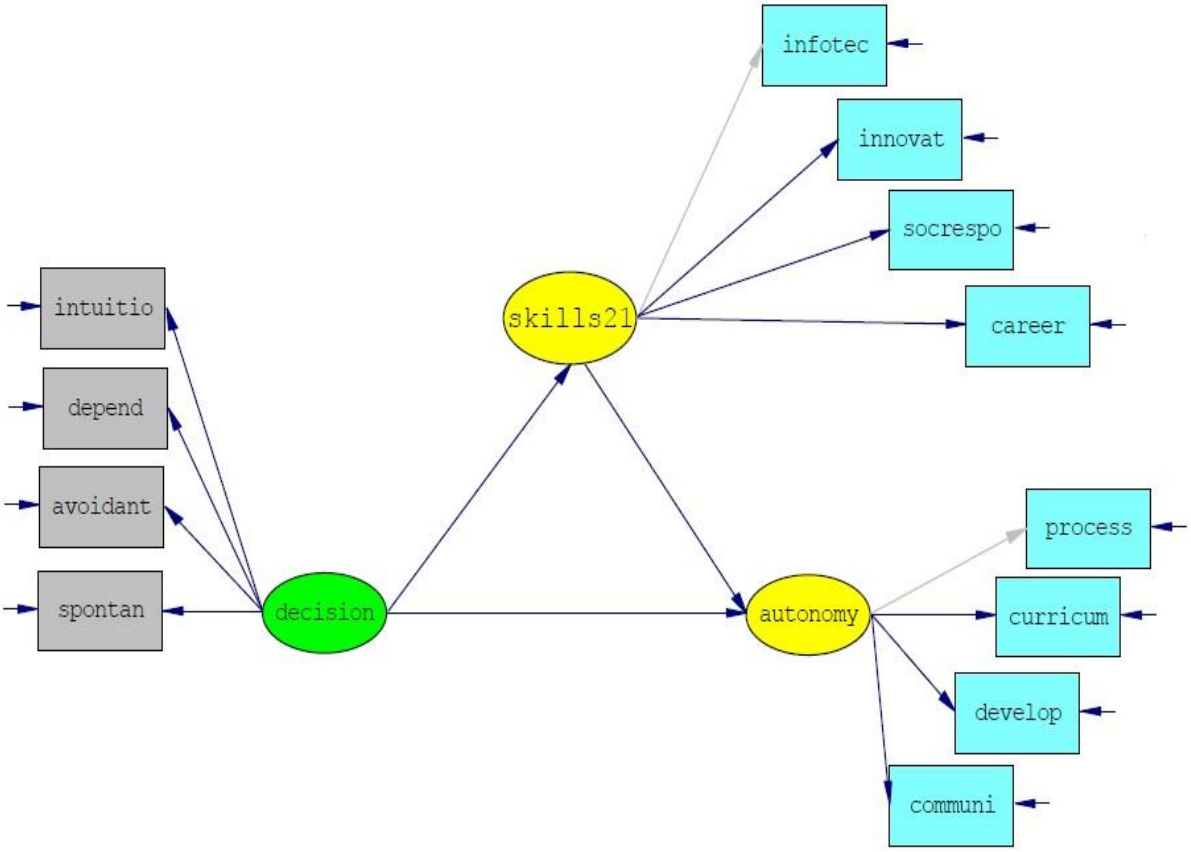
H4: There is a mediation effect of teachers' 21st century skills between teachers' decision making styles, and teachers' professional autonomy.

METHOD

RESEARCH DESIGN

The research was based on the correlational research design. The correlational research design is defined as a research model that aims to determine the existence and/or degree of change between two or more variables (Karasar, 2019). In the correlational research, it is tried to reveal whether there is a type of relationship, which type of relationship there is, or at what level there is a relationship (Büyüköztürk et al., 2018). In this respect, the theoretical model, developed for the description of the direct relationships between teachers' 21st century skills, decision making styles, and professional autonomy and the mediation role of 21st century skills in the direction of professional autonomy of teachers' decision making styles, was tested. In the basic mediation model, the variable called the mediator variable is a part of the cause and effect relationship that affects the relationship between the dependent and independent variables (MacKinnon, Fairchild & Fritz, 2010). The model created based on the theoretical framework is shown in Figure 2.

Figure 2. *Theoretical Model of the Effect of Decision Making Styles and 21st Century Skills on Teachers' Professional Autonomy*



POPULATION AND SAMPLE

The study population consists of approximately 910 teachers working in different school types in Nazilli district of Aydın province during the 2021-2022 academic year. In the research, the maximum diversity sampling method was used as a purposive sampling technique. The maximum diversity sampling method is defined as the identification of events and phenomena within the population that contain similarities and differences, which are assumed to exist, and conducting the study on the identified specific cases (Büyüköztürk, Çokluk & Köklü, 2014). Considering that the diversity in the sample would arise from the variables of school type and branch, teachers working in different branches at the elementary school, middle school, and high school were reached. The distribution of teachers according to branches and school types is shown in Table 1. The sample size was determined using the sample size table. It is stated that the study population of 750 people can represent 254 people at α=0.05 significance and a %5 confidence level (Can, 2014). In this context, feedback was obtained from 435 voluntary teachers. In terms of research ethics, teachers were not asked to provide identifying information.

Table 1. *Demographic Characteristics of Teachers*

Variables	*Groups*	*N*	*%*
Gender	Male	191	43,9
	Female	244	56,1
Age	20–30	104	23,8
	31–40	204	46,8
	41–50	101	23,4
	51 and more	26	6
Professional Seniority	0–5	78	17,9
	6–10	127	29,2
	11–15	107	24,6
	16–20	63	14,5
	21 and more	60	13,8
School Type	Primary School	79	18,2
	Secondary School	171	39,3
	High School	185	42,5
Branch	Numerical Field Teachers	122	28,04
	Equal Field Teachers	111	25,52
	Verbal Field Teachers	140	32,19
	Foreign Language Field Teachers	62	14,25
	Total	435	100

DATA COLLECTION INSTRUMENTS

PERSONAL INFORMATION FORM

The personal information form, including questions about gender, age, professional seniority, school type, and branch, was prepared by the researchers.

MULTIDIMENSIONAL 21ST CENTURY SKILLS SCALE (MDCSS)

The scale, developed by Çevik and Şentürk (2019), consists of 41 items and five dimensions as a 5-point Likert scale. In this scale, items 1.-15. are used for information and technology literacy, items 16.-21. for critical thinking and problem-solving, items 22.-31. for entrepreneurship and innovation, items 32.-35. for social responsibility and leadership, and items 36.-41. for career consciousness. Çevik and Şentürk (2019) determined the reliability coefficients of the original scale as 0.84 for information and technology literacy, 0.79 for critical thinking and problem-solving, 0.76 for entrepreneurship and innovation, 0.73 for social responsibility and leadership skills, 0.75 for career consciousness, and 0.86 for the total scale. The validity and reliability studies of the measurement tool were conducted on a study group consisting of 660 high school, associate degree, and undergraduate students in the 15-25 age group. The correlation coefficients of the items ranged between 0.32 and 0.87. The Chi-square ($\chi 2$) value was found to be 2014.17, and the standard deviation (SD) value was 774.

Confirmatory factor analysis (CFA) was conducted using the Lisrel 8.80 software package to establish the construct validity, and as a result, seven items were removed from the scale. Modification was made between items 1.-3., 9.-10., 17.-18., and 39.-40. to achieve acceptable fit values and ensure construct validity. In order to establish construct validity, each sub-dimension should include a minimum of three items to represent the respective dimension (Büyüköztürk, 2011; Kline, 2000). After the removal of items, it was observed that the sub-dimensions still consisted of more than three items. The amount of explained variance and Cronbach's Alpha coefficients in the original study were found to be similar to those in this study. The Cronbach's Alpha reliability coefficients of this study were determined as 0.89 for information and technology literacy, 0.84 for critical thinking and problem-solving, 0.88 for entrepreneurship and innovation, 0.66 for social responsibility and leadership, 0.76 for career consciousness, and 0.88 for the total scale. Similar results were obtained in terms of the

same structure and reliability levels even after removing the items from the measurement tool. Therefore, it is believed that the removal of items did not have any negative impact on the psychometric properties of the measurement tool. Various studies (Canpolat, 2021; Engin & Korucuk, 2021; Geçgel et al., 2022; Güllü & Akçay, 2022; Varki, 2020) have confirmed that the scale has high reliability and validity coefficients. Furthermore, the scale was chosen due to its parallelism with the main skills that teachers should possess according to MoTNE (2005), as critical thinking, creative thinking, communication, problem-solving, research, use of information technologies, and entrepreneurship, as well as its compilation of prominent skills highlighted in the literature. In this context, the subdimensions used in the study were preferred as indicators of 21st century skills for teachers.

DECISION MAKING STYLES SCALE (DMSS)

The scale, developed by Scott and Bruce (1995), consists of 25 items as a 5-point Likert-type. It was adapted into Turkish by Taşdelen (2002). The scale includes items 1.-5. for rational decision making, items 6.-10. for intuitive decision making, items 11.-15. for dependent decision making, items 16.-20. for avoidant decision making, and items 21.-25. for spontaneous decision making style. Taşdelen (2002) calculated the reliability coefficients of the original scale as 0.76 for rational decision-making style, 0.78 for intuitive decision making, 0.76 for dependent decision making, 0.79 for avoidant decision making, 0.79 for spontaneous decision making, and 0.74 for the total scale. Scott and Bruce (1995) and Taşdelen (2002) found internal consistency coefficients for the sub-dimensions ranging between α = 0.79-0.94 and α = 0.74-0.89, respectively. The original study was conducted on 451 students in the fourth grade of the Faculty of Education at Pamukkale University during the 2001-2002 academic year.

After CFA for construct validity, one item was removed from the scale. Modification was made between items 2.-3., 6.-7., and 16.-17. to achieve acceptable fit indices and ensure construct validity. The removal of one item did not decrease the number of items below three for each sub-dimension, thereby maintaining the requirement of having at least three items for construct validity (Büyüköztürk, 2011; Kline, 2000). Additionally, the Cronbach's alpha coefficients from both studies were parallel. In this study, the Cronbach's alpha reliability coefficients were determined as 0.86 for rational decision making, 0.87 for intuitive decision making, 0.88 for dependent decision making, 0.92 for avoidant decision making, 0.83 for spontaneous decision making, and 0.88 for the total scale. Despite the removal of an item, the structure and reliability were maintained at the same level, indicating that the psychometric properties of the measurement tool were not compromised. The reason for choosing the decision making styles scale classified by Scott and Bruce (1995) is due to its psychometric properties. Various studies (Akdeniz & Korkmaz, 2023; Çar et al. 2023; İme, Kalı-Soyer & Keskinoğlu, 2020; Pesen & Epçaçan, 2021; Sakallı, 2019) have confirmed the high reliability and validity coefficients of the scale.

TEACHER AUTONOMY SCALE (TAS)

The measurement tool, developed by Çolak and Altınkurt (2017), is a 5-point Likert scale consisting of 17 items and four dimensions. The items 1., 3., 4., 9., 10., and 11. represent teaching autonomy; items 2., 5., 6., 7., and 8. represent curriculum autonomy; items 12.-14. Represent professional development autonomy, and items 15.-17. represent professional communication autonomy. The original scale's reliability coefficients were found to be 0.77 for teaching autonomy, 0.80 for curriculum autonomy, 0.75 for professional development autonomy, 0.80 for professional communication autonomy, and 0.87 for the total scale. The research was conducted on 434 teachers working in public and private preschool, primary, middle, and high schools in the central and district regions of Muğla province during the 2015-2016 academic year. According to the factor analysis of the scale, the KMO value was 0.87, and the Bartlett's Test of Sphericity was significant [$\chi 2$ = 1945.74; p = .00].

To achieve acceptable fit values, modifications were made between items 1.-3., 2.-5., 3.-4., 10.-11., and 16.-17., ensuring construct validity. The Cronbach's alpha reliability coefficients of this study were found to be 0.80 for teaching autonomy, 0.80 for curriculum autonomy, 0.70 for professional development autonomy, 0.72 for professional communication autonomy, and 0.88 for the total scale. The high validity and reliability coefficients in different studies (Bozkurt & Kara, 2022; Çolak et al., 2023; Demir, 2023; Esen, 2023; Yolcu & Selvitopu, 2022) have been determining factors in choosing the scale.

DATA ANALYSIS

The scales were implemented via Google Forms as part of the Covid-19 measures. The data from 435 teachers was transferred to "IBM SPSS Statistics 25" and "Lisrel 8.80". Average scores for each scale's sub-dimensions were obtained, and the analyses were conducted based on the average scores for the sub-dimensions.

To determine the normality assumption of each scale's data, the Kolmogorov-Smirnov and Shapiro-Wilk tests were used. Additionally, graphical methods such as histogram plots and box plots were examined. The skewness and kurtosis coefficients were found to be within the range of -1 and +1, the measures of central tendency (mean, mode, and median) were close to each other, and the points on the Q-Q plots did not deviate from the lines. Based on these observations, it was concluded that the results obtained from the scales followed a normal distribution (Nunnally & Bernstein, 1994). To determine the linearity relationship between variables, scatter plots were evaluated. When the results from pairwise scatter plots for each variable were considered as a whole, a linear relationship between the variables was identified. The Levene test for homogeneity of variances did not yield statistically significant results, indicating that the assumption of homogeneity of variances was met. The assumptions of multicollinearity and autocorrelation, which are relevant to regression analysis, were examined using the Durbin-Watson coefficient and variance inflation factor. The Durbin-Watson coefficients were within the range of 1.5 and 2.5, the inflation amount of variance was below 5, and the tolerance value was above 0.2. Therefore, it was concluded that all the necessary assumptions for regression analysis were met (Tabachnick & Fidell, 2013).

In the first stage, CFA were conducted using Lisrel 8.80 to assess the construct validity of the scales. As a result of these analyses, 7 items from the MDCSS and one item from the DMSS were removed because they fell below the critical value of 1.96 (Şimşek, 2020). No items were removed from the TAS. The remaining items were adjusted to achieve acceptable goodness-of-fit values based on standardized criteria. In this context, after the modifications, related values for the MDCSS were obtained as 3.30 for the χ^2/df; 0.82 for GFI; 0.79 for AGFI; 0.95 for CFI; 0.93 for NFI; 0.95 for IFI; and 0.073 for RMSEA. Related values for the DMSS were obtained as 2.47 for χ^2/df; 0.90 for GFI; 0.87 for AGFI; 0.97 for CFI; 0.95 for NFI; 0.97 for IFI and 0.058 for RMSEA. Related values for the TAS were obtained as 3.68 for χ^2/df; 0.90 for GFI; 0.86 for AGFI; 0.96 for CFI; 0.94 for NFI; 0.96 for IFI and 0.079 for RMSEA. The results of the research model's fit values, along with the excellent and acceptable fit values according to RMSEA, NFI, CFI, IFI, and GFI indicating that the model fit has been achieved (Karagöz, 2019), can be seen in Table 2.

Table 2. The *Goodness of Fit Values of the Scales at the End of Confirmatory Factor Analysis with Perfect and Acceptable Fit Criteria*

Fit Indexes	*Excellent Fit Criteria*	*Acceptable Fit Criteria*	*MDCSS*	*DMSS*	*TAS*
[1]CMIN/DF<5	0 ≤ χ2 /sd ≤ 2	2 ≤ χ2 /sd ≤ 3	3,30	2,47	3,68
[2]AGFI>0,80	.90 ≤ AGFI ≤ 1.00	.85 ≤ AGFI ≤ .90	0,79	0,87	0,86
[3]GFI>0,85	95 ≤ GFI ≤ 1.00	.90 ≤ GFI ≤ 95	0,82	0,90	0,90
[3]CFI>0,90	.95 ≤ CFI ≤ 1.00	.90 ≤ CFI ≤ .95	0,95	0,97	0,96
[3]NFI>0,90	.95 ≤ NFI ≤ 1.00	.90 ≤ NFI ≤ .95	0,93	0,95	0,94
[3]IFI>0,90	.95 ≤ IFI ≤ 1.00	.90 ≤ IFI ≤ .95	0,95	0,97	0,96
[4]RMSEA< 0,08	.00 ≤ RMSEA ≤ .05	.05 ≤ RMSEA ≤ .08	0,073	0,058	0,079

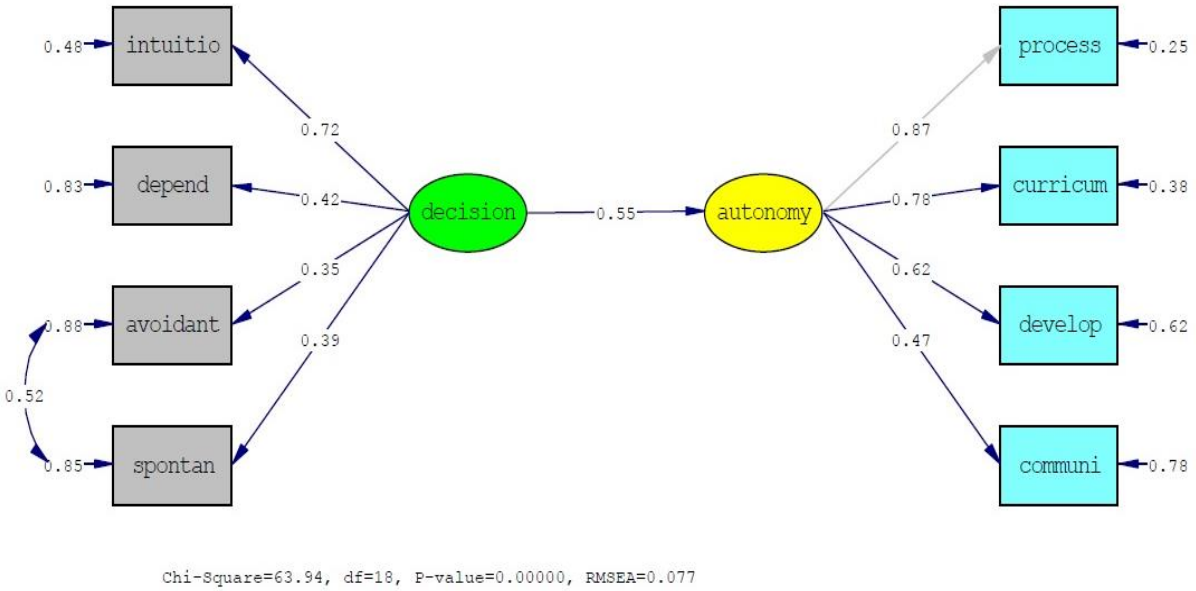
[1](Kline, 2011), [2](Schermelleh-Engel & Moosbrugger, 2003), [3](Baumgartner & Homburg, 1996; Bentler, 1980; Bentler & Bonett, 1980; Marsh et al., 2006), [4](Browne & Cudeck, 1993)

In the second stage, the three-step path analysis by Baron and Kenny (1986) was used to test the theoretical model. In this analysis, the independent variable should have an effect on the dependent variable and the mediating variable. When the mediating variable is included in the path analysis along with the independent variable, it is expected that the effect of the independent variable on the dependent variable will decrease while the significant effect of the mediating variable on the dependent variable will persist (Avcı & Turunç, 2012). A decrease in the coefficient of the independent variable in the analysis indicates partial mediation, while the complete elimination of this relationship indicates full mediation (Arı, Bal & Bal, 2010). To statistically explain these relationships, the significance of the z-value in the Sobel test needs to be examined (Gücel, 2013). In this context, the Sobel test was used to confirm the mediation in the model. All measurements were interpreted using the significance level of 0.05, for educational researches.

FINDINGS

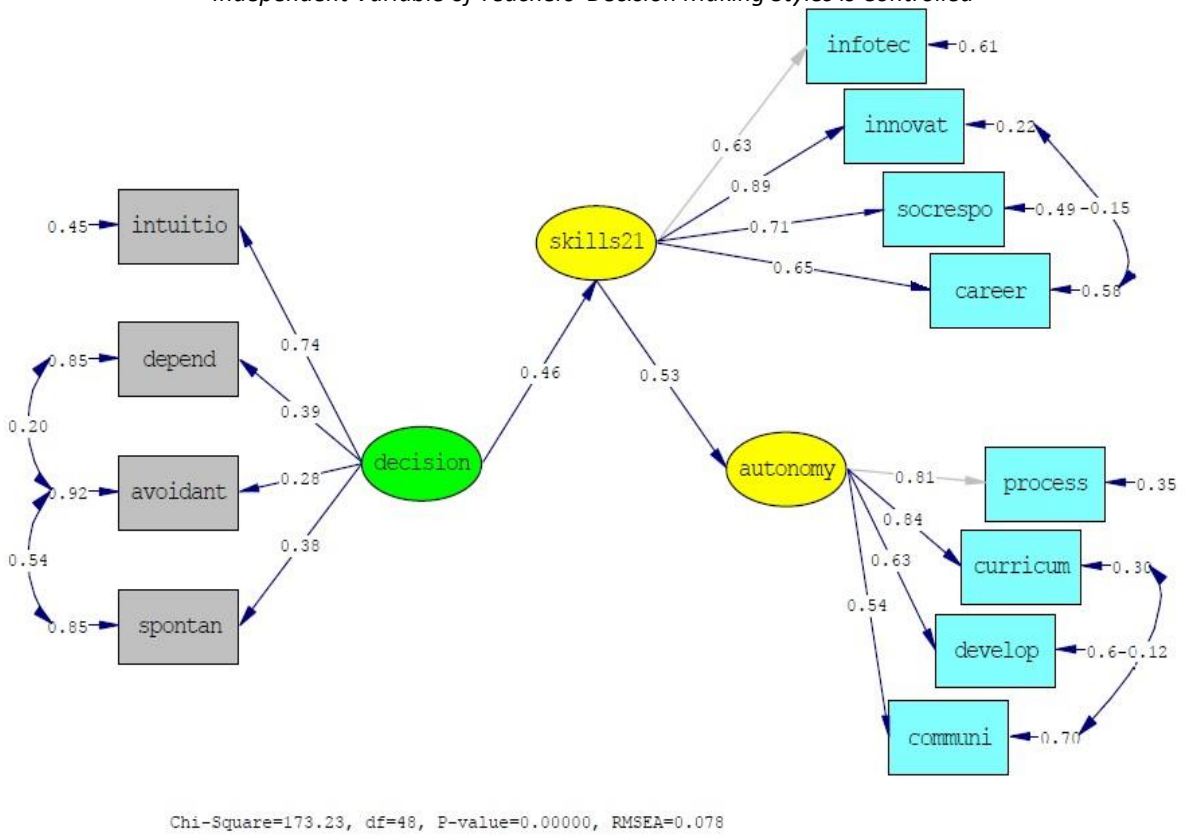
In the first stage, when examining the relationship between teachers' decision making styles and professional autonomy in the sub-dimensions; the rational decision making style sub-dimension was removed from the analysis because it fell below the critical t-value of 1.96 (Şimşek, 2020). Then, when examining the χ^2/df value, if it is less than 5, it is considered an acceptable value, but if it is less than 3, it is considered a good value (Klem, 2000). An RMSEA of 0.08 or lower is considered an acceptable fit of error estimate (Heubeck & Neill, 2000; Thompson, 2000). Modification was made on the model between the avoidance and spontaneous decision making styles, and it was observed that the model had a χ^2/df value of 3.55 (63.94/18), and an RMSEA value of 0.077, which is less than 0.80. Additionally, the AGFI of the model was determined as 0.93, NFI as 0.95, and CFI as 0.96. Therefore, the relationship between teachers' decision making styles and professional autonomy was found to be statistically significant with a value of 0.55.

Figure 3. *The Relationship between Teachers' Decision Making Styles and Professional Autonomy*



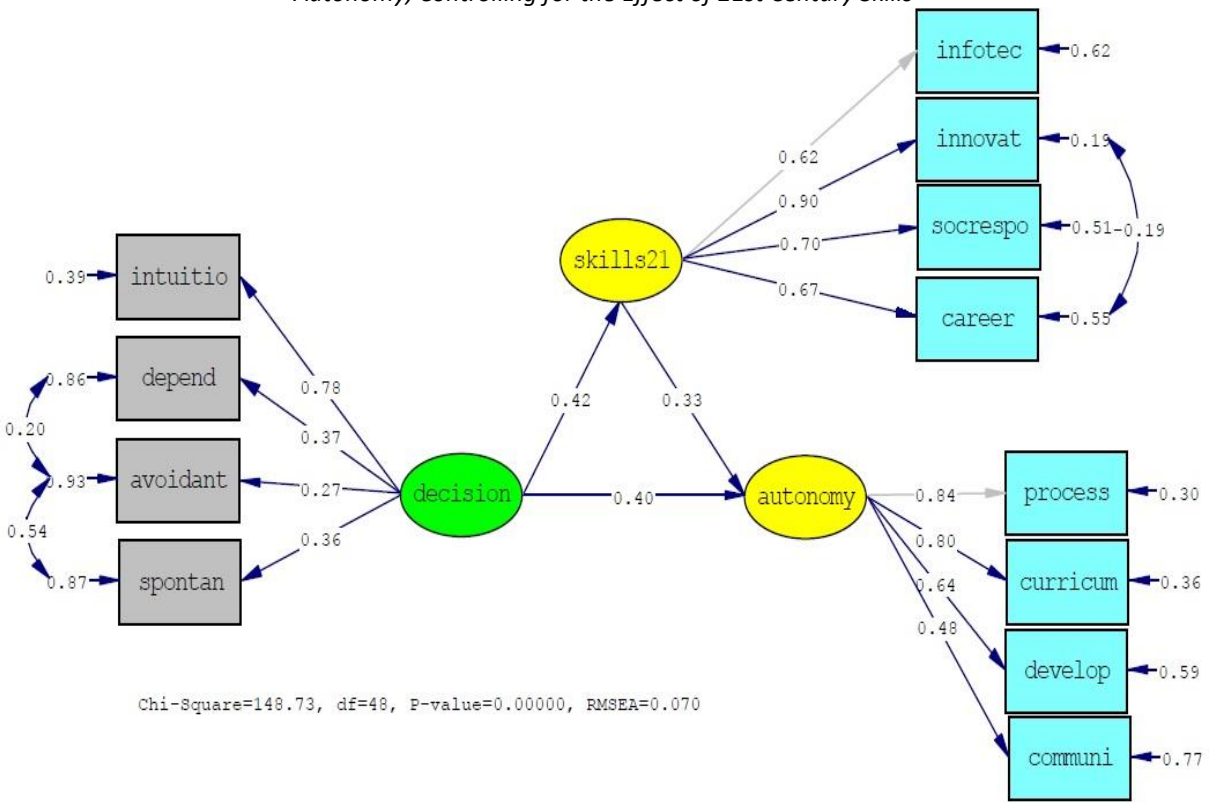
In the second stage, when evaluating the relationships between teachers' decision making styles and 21st century skills, as well as 21st century skills and professional autonomy in the sub-dimensions; critical thinking and problem-solving skills and rational decision making style were removed from the model because they fell below the critical t-value of 1.96 (Şimşek, 2020). Modifications were made between dependent and avoidance decision making styles, between avoidance and spontaneous decision making styles, between entrepreneurship and innovation and career consciousness skills, and between curriculum and professional communication autonomies for the fit values. As a result, it was observed that the model had a χ^2/df value of 3.60, and an RMSEA value of 0.078, which is less than 0.80 (given in Figure 4). Additionally, the AGFI of the model was 0.90, NFI 0.93, and CFI 0.95. According to the results, there is a statistically significant relationship between teachers' decision making styles and 21st century skills with a value of 0.46, and when controlling for the effect of the decision making styles as an independent variable, there is a significant relationship between 21st century skills and professional autonomy with a value of 0.53.

Figure 4. *The Relationship between 21st Century Skills and Professional Autonomy when the Effect of the Independent Variable of Teachers' Decision Making Styles is Controlled*



In the final stage, when evaluating the relationships between teachers' decision making styles and 21st century skills, as well as 21st century skills and professional autonomy, and decision making styles and professional autonomy in the sub-dimensions; critical thinking and problem-solving skills and rational decision making style were removed from the model because they fell below the critical t-value of 1.96 (Şimşek, 2020). Modifications were made between dependent and avoidance decision making styles, between avoidance and spontaneous decision making styles, and between entrepreneurship and innovation and career consciousness skills for the fit values. As a result, it was observed that the model had a χ^2/df value of 3.61 (173.23/48), and an RMSEA value of 0.070, which is less than 0.80 (given in Figure 5). Additionally, the AGFI of the model was as 0.90, NFI as 0.93, and CFI as 0.95. Therefore, there is a statistically significant relationship between teachers' decision making styles and 21st century skills with a value of 0.42, when controlling for the effect of decision making styles as an independent variable. There is also a significant relationship between 21st century skills and professional autonomy with a value of 0.33, and when controlling for the effect of 21st century skills, there is a relationship of 0.40 between decision making styles and professional autonomy.

Figure 5. *The Theoretical Model of the Relationship between Decision Making Styles and Professional Autonomy, Controlling for the Effect of 21st Century Skills*



When the model data fit is examined, it was seen that the χ^2/df value of the model was 2.97 (142.81/48), and the RMSEA value of 0.070, which was less than 0,08. In addition, the AGFI of the model was 0.91, the NFI 0.94 and the CFI 0.96. When the obtained fit statistics were evaluated as a whole, it was concluded that the model data fit was achieved. The total effect of teachers' decision making styles on their professional autonomy is found to be 0.55, and when 21st century skills are included in the model, this effect decreases to 0.40, which is still significant. In the literature, it is stated that if the relationship between variable X (decision making styles) and variable Y (professional autonomy) shows a decrease when variable M (21st century skills) is included, as long as it is different from zero, it indicates a significant mediating relationship (Preacher & Hayes, 2004; MacKinnon, 2008; Judd & Kenny, 2010; Rucker et al., 2011). In this context, the findings suggest that 21st century skills partially mediate the relationship between teachers' decision making styles and professional autonomy.

The amount of variance (R^2) explained by the model for 21st century skills and decision making styles has been examined. When the direct effect of decision making styles on professional autonomy is examined, it explains %30 of autonomy. When the direct effect of decision making styles on 21st century skills is examined, it explains %21 of 21st century skills. When the direct effect of 21st century skills on professional autonomy is examined, it explains %28 of autonomy. It has been determined that decision making styles and 21st century skills together explain %38 of the total variance in professional autonomy. Therefore, with the model, 21st century skills have increased the proportion of teachers' decision making styles in explaining their professional autonomy. It can be said that 21st century skills account for %38 of the underlying behaviours and reasons in explaining which styles teachers are inclined to in the decision making process regarding their professional autonomy.

Finally, a Sobel test was conducted to demonstrate the significance of the mediating role of 21st century skills in the impact of teachers' decision making styles on their professional autonomy. The Sobel test confirmed the statistical significance of the mediating effect, and the significance of the indirect effect was also supported by the Sobel z-value ($z=3.91$; $p<.05$). In light of these findings, when 21st century skills were added to the model, the influence of decision making style decreased but remained significant, indicating that 21st century skills act as a partial mediating variable.

DISCUSSION, CONCLUSION AND IMPLICATIONS

In this study, a theoretical model was tested regarding the mediating role of teachers' 21st century skills in the relationship between teachers' decision-making styles and professional autonomy. Due to the multidimensional nature of the measurement tools, direct and indirect effects were examined along with the sub-dimensions. The research results indicate that decision making styles have a direct impact on teacher autonomy. Öztürk (2011) stated that it is challenging to establish a universally valid autonomy model worldwide, but autonomy approach cannot exist without the active participation of teachers in decisions related to school management. Öztürk emphasized that teachers should not only be implementers but also decision makers. Ertürk (2020) highlighted the importance of teachers' ability to make important decisions professionally in teacher autonomy. Ertürk defined the authority and desire to make decisions related to job-related behaviours as a precondition for the free use of professional expertise. Kılıç, Bozkurt, and İlhan (2018) concluded in their qualitative paradigm study that teacher autonomy should provide freedom by involving teachers in decision making processes. Ulaş and Aksu (2015) see having a say in school decisions as an element of autonomy. Bozkurt and Kara (2022) found that teachers feel more autonomous in educational processes where they can make direct decisions. Additionally, involving teachers in the decision making processes in schools has been suggested to promote autonomy. The findings of this study are consistent with these studies as they also focus on the influence of decision making behaviours on autonomy.

Maviş-Sevim (2020) aimed to determine teachers' views on their autonomy in decision making processes and their participation in these processes in qualitative research. According to teachers' views, although many teachers feel competent in decision making, they do not have autonomy. When these variables, which are examined as a theoretical model, are addressed in a qualitative study, the finding that decision making behaviour does not lead to autonomy constitutes a contradictory result. The reason of different results from two studies can be explained by school standards. Especially when autonomy is concerned for teachers; school principals and parents play a suppressing role. Additionally, factors that hinder autonomy are associated with centralized programs and exams in some studies (Aksoy & Gözütok, 2017; Glass, 1997; Moomaw, 2005; Ramos, 2006; Yazıcı & Akyol, 2017). These situations may be the reason why autonomy, which should theoretically occur, does not manifest in practice.

According to the research results, decision making styles have a direct impact on teachers' 21st century skills. Belet-Boyacı and Güner-Özer (2019)'s study states that individuals who have 21st century skills and use them as a superior identity have correct decision making mechanisms in order to establish a place and have a say in society. This finding, which suggests that having 21st century skills, influences decision making, is not consistent with the findings of this study. The reason for this discrepancy can be explained by the fact that Belet-Boyacı and Güner-Özer's study was conducted through a literature review, while this study was conducted with data from teachers. At this point, the difference between the studies is not seen as a disadvantage, and it is also considered that there can be a bidirectional relationship between 21st century skills and decision making.

According to the research results, it was found that 21st century skills have a direct impact on teacher autonomy. Koçak and Karatepe (2022) emphasize in their study that there is a positive and

significant relationship between autonomy and 21st century teaching skills. This indicates that as teachers' 21st century teaching skills increase, their level of autonomy may also increase. The 21st century teaching skills scale consists of sub-dimensions such as management, techno-pedagogical, approving, flexible teaching, and productivity skills. Despite their study with a different scale, Koçak and Karatepe obtained similar results. Considering that the two scales may show parallelism in skills such as management, technology, flexibility, and productivity; the findings of their study support this result.

The most significant result of this study is that the mediating role between teachers' 21st century skills and their decision making styles in relation to professional autonomy is statistically significant, and all hypotheses related to mediation have been confirmed. In light of these findings, it was observed that the effect of decision making styles decreases but remains significant after adding 21st century skills to the model, indicating that 21st century skills act as a partial mediating variable in this relationship. This relationship implies that teachers' mastery of 21st century skills in decision making situations related to professional autonomy plays a determining role, and it can be said that a prerequisite for being professionally autonomous as a teacher is the sufficient utilization of 21st century skills in decision making style tendencies. Therefore, rational and logical decisions supported or developed by teachers with 21st century skills indicate the experience of an autonomous process in the areas of the educational process, educational programs, professional development, and communication.

It is an expected finding that decision making styles significantly influence teachers' professional autonomy through 21st century skills. However, no research findings were found in the literature where the direct and indirect effects of these three variables were simultaneously tested. However, according to Gerrig and Zimbardo (2018), the decision making process involves actions such as goal setting, information gathering, option identification, analysis, evaluation, and interpretation. According to Deniz, Çok, and Duyan (2013), autonomy means assuming responsibility for decisions and actions with free will without completely separating from the decisions and behaviours exhibited. At this point, it is believed that decision making is a prerequisite for autonomy based on the definition of autonomy itself. Ramos (2006) explains the development of autonomy behaviours among teachers with the concepts of self-awareness, awareness, problems, participation and collaboration, responsibility, and changing roles. Bozkurt (2018) and Özgüzel (2018) list the 21st century skills that a qualified individual should possess as research, inquiry, creativity, critical and analytical thinking, decision making, and generating solutions to complex situations. In this context, it was anticipated that decision making and autonomy would have similarities within the scope of 21st century skills due to the shared and similar expressions such as research, inquiry, information gathering, analysis, analytical thinking in decision making definitions, and expressions such as decision making, problem-solving, responsibility, collaboration, and participation in autonomy definitions. These similarities support the structure of the theoretical model developed in this study. This situation provides evidence for the necessity of establishing this theoretical model and the effectiveness of the model.

According to the research results, in-service trainings can be provided to support the development of 21st century skills in areas such as knowledge and technology, critical thinking, problem solving, entrepreneurship, innovation, social responsibility, leadership, and career awareness. It is predicted that teachers, who develop in 21st century skill areas, will have a positive influence on their professional autonomy behaviours through rational tendencies in decision making styles. Specifically, identifying strengths and weaknesses within the scope of 21st century skills and focusing on developing weaknesses and channelling strengths into the right areas can be encouraged. Interactive development can be facilitated by creating working groups between teachers with high and low levels of 21st century skills. Training programs suitable for decision making styles can be organized by determining teachers' decision making behaviours, attitudes and styles to enable them to make rational decisions. As a result, teachers' autonomy levels should be determined in terms of the

teaching process, curriculum, professional development, and communication. Factors that hinder autonomy should be identified and eliminated, and teachers' professional autonomy should be supported and enhanced. Furthermore, the relationship between 21st century skills, decision making styles, and autonomy variables can be reflected in pre-service and in-service teacher training programs. Program design and development studies can be conducted to reflect this relationship. Decision making training programs can be created with the help of 21st century skills. The effects can be monitored through quantitative and qualitative research on the implementation of the programs.

Despite the existence of many studies on 21st century skills, decision making styles, and teachers' autonomy, there is a lack of study that addresses these three variables within a single model. Therefore, it is expected that this study will contribute to the literature. To obtain similar or different results on this research topic, the study can be conducted with a different design or sample group. The study is limited to teachers working in schools located in the Nazilli district of Aydın province during the 2021-2022 academic year. Specifically, the obtained data can be complemented and compared with qualitative research on similar topics. Additionally, this study was conducted across all levels and disciplines. Therefore, it is suggested to restructure the research by selecting schools and teachers from different regions, cities, and levels at different times. Particularly, including academics, who play an important role in teacher education in this study, and comparing them with practicing teachers based on this data can yield different results. Moreover, the study conducted with three variables can be carried out with different variables or the model can be retested by adding new variables.

ETHICS

During the 2021-2022 academic year, with the decision numbered E-74083975-605.01-45076192 taken from Aydın Governorate, official permissions and ethical permissions were obtained from the Aydın Directorate of National Education to conduct the research.

AUTHOR CONTRIBUTIONS

All authors have made substantial contributions to the manuscript development and preparation.

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Effective Use of Distance Education Tools in Higher Education During Covid-19 Pandemic in Türkiye

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Abstract

In this study, it was aimed to determine the attitude of students at state universities towards the effective use of distance education tools during the COVID-19 pandemic in Türkiye. This study was conducted within the scope of the Technology Acceptance Model by using a relational survey design. The sample consisted of 4.118 undergraduates from different public universities. The results showed that technology acceptance scores (TAS) of undergraduate students were higher than associate degree students. In addition, TAS increases as the duration of distance education use increases. A strong positive correlation was found between university students' perceptions of experience, enjoyment, and self-efficacy and the perceived benefit and ease of use of distance education. Perceived usefulness and perceived ease of use are determinants of the intention to use and attitude towards using distance education systems. The research also identified that university students' intention to use the system and their attitude towards using it have positive effects on behavior during actual use. In conclusion, it may be asserted that, distance education is an indispensable system in terms of providing quality education services and developing human resources in times of crisis.

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INTRODUCTION

During the COVID-19 pandemic, countries have made great efforts to avoid problems in education and to ensure the continuity of education service by using all the means at their disposal. This made it necessary and imperative to use technology in developing human resources. Since university students are perceived as the potential human resources, in this study we focused on the effective use of distance education tools in higher education based on the Technology Acceptance Model (TAM) (Rizun & Strzelecki, 2020). In current study, regarding the perceptions of undergraduates in Türkiye, the effective use of distance education tools, and its role of distance education was examined.

Almost all of the education systems in the world tried to fight against coronavirus (COVID-19) pandemic and found ways to continue education during the epidemic (Sari & Nayir, 2020). COVID-19 crisis emerged at a time when most of the education systems were not ready for the world of digital learning opportunities, according to the latest report from the OECD's International Student Assessment Program (PISA) (OECD, 2020). In other words, the Coronavirus has revealed that education systems around the world are not ready for times of crisis. Students from remote and impoverished locations faced numerous obstacles, including limited technical access, inadequate internet connectivity, and adverse study conditions (Sakka, 2022). COVID-19 pandemic has changed the way of learning in higher education (Simamora, 2020). Online and distance learning is a necessity in times of lockdowns and social distancing due to COVID-19 pandemic (Ali, 2020). Moreover, Yaylak (2022) asserts that distance education is indispensable in maintaining education services and using technology in education during the COVID-19 process. Students consider distance learning as the interesting, modern, adequate, and convenient, but it doesn't able to replace their experience of social interaction with fellow students and teachers (Kedraka & Kaltsidis, 2020). On the contrary, Alawamleh, Al-Twait, and Al-Saht (2022) found that students preferred face-to-face lessons more than online lessons due to many problems during the COVID-19 process. These problems are feeling of loneliness caused by online lessons, lack of motivation, lack of understanding of the subject, decreased communication between students and instructors. In particular, the reflections of the suspension of face-to-face education and the transition to emergency distance education will be more clearly understood in the following years (Izgı-Onbaşılı & Sezginsoy-Şeker, 2021).

Countries have been pushed to expand their use of distance education and make it mandatory in view of the danger of being unable to resume face-to-face education (Masalimova et al., 2022). In Türkiye, due to COVID-19 pandemic, face-to-face education has largely been replaced by distance education practices (Keskin & Ozer-Kaya, 2020). Literature review revealed different variables affecting students' effective use of distance education tools. These variables are internet access, having a computer, motivation, perception regarding distance education, knowledge and experience, perceived usefulness, and flexibility (Ibicioglu & Antalyali, 2005; Sahin & Shelley, 2008). In addition, numerous factors that determine the satisfaction level of university students regarding distance education tools are mentioned. These factors are expressed as the quality of live courses, the course contents, the quality of videos, ease of access, technological support, and possibilities to watch the recordings afterwards (Yilmaz-Ince et al., 2020).

In studies conducted within the scope of TAM, various external variables that affect the attitude of individuals to accept technology are mentioned. These are experience, computer anxiety, enjoyment, self-efficacy, subjective norms, and quality (Abdullah et al., 2016; Aypay et al., 2012; Efiloglu-Kurt, 2015; Lau & Woods, 2008; Lee et al., 2014; Park et al., 2012; Pituch & Lee, 2006; Rizun & Strzelecki, 2020; Wang & Wang, 2009). In this sense, system and user characteristics have a significant effect on use of technology as the external variables. Moreover, external variables also affect perceived ease of use and perceived usefulness in adopting a technology (Davis et al., 1989). In other words, the suitability of external factors enhances the efficiency of the lessons, and so, increases the

adoption level of students' distance education application and their active participation. In current study, Technology Acceptance Model was adopted as a research design (Rizun & Strzelecki, 2020) considering self-efficacy (SE), enjoyment (ENJ), computer anxiety (CA), experience (EXP), perceived ease of use (PEoU), perceived usefulness (PU), intention to use (ITU), attitude towards use (ATU), and actual use (AU). Regarding the results from previous studies, the sub-dimensions of the model are discussed below.

SELF-EFFICACY (SE)

The most well-known definition of SE is the confidence level displayed by individuals who successfully use a particular system. Zimmerman (1995) defines SE as people's positive judgments about their ability to organize and implement the action plans necessary to achieve certain types of performance. According to Wood and Bandura (1989), SE is people's perceptions of their belief in their ability to activate the motivation, cognitive resources, and action pathways they need to gain control over the events or phenomena they encounter. SE is also related to previously experienced knowledge systems (Bandura, 1977; Wang & Wang, 2009). In this sense, SE perception of students is significant to ensure participation and encourage learning in distance education (Sun & Rueda, 2012).

SE beliefs affect an individual's cognitive, motivational, and emotional attitudes as well as decision making. Numerous studies have included the findings that SE beliefs are a strong predictor of PEoU and PU (e.g., Abdullah et al., 2016; Igbaria & Livari, 1995; Liaw & Huang, 2013). In addition, the research results of Venkatesh and Davis (1996, 2000) reveal that the perception of computer self-efficacy is a strong predictor of the perception of ease of using certain systems in individuals. The results of different studies not only reveal a positive relationship between SE and PEoU, but also reveal that SE also positively affects PEoU (e.g., Abbad et al., 2009; Aypay et al., 2012; Davis et al., 1989; Lee et al., 2013; Motaghian et al., 2013; Pituch & Lee, 2006; Wu et al., 2013). For instance, Lee et al. (2014) found that while computer and internet self-efficacy has a positive effect on PEoU and PU, computer SE does not have a significant effect on PU.

There are also studies in the literature showing that SE beliefs do not have a significant effect on PEoU and PU. For instance, according to the results of the research conducted by Lau and Woods (200 8), the perception of SE does not have a significant effect on individuals' PU and PEoU of learning tools. Similarly, a study by Rezaei et al. (2008) includes findings that there is no significant relationship between individuals' SE perceptions and their PEoU of using technological tools. There are many studies in the literature that include the finding that technological SE belief does not have a significant effect on PU from technological tools (Aypay et al., 2012; Lee et al., 2013; Motaghian et al., 2013; Pituch & Lee, 2006).

ENJOYMENT (ENJ)

ENJ in the context of using a technological system or information system is only an indication of how enjoyable it is to use a particular system (Park et al., 2012). Shyu and Huang (2011) argue that individuals' perceived ENJ of technological tools has a positive effect on PEoU. According to Al-Gahtani (2016) and Al-Ammary et al. (2014), the ENJ individuals perceive in the process of using technological tools is a significant predictor of their PEoU of these tools. In addition, Park et al. (2012) found that individuals' perceived ENJ in the web-based education process has a significant positive effect on their PU from this education. However, in the same study it was reported that perceived ENJ of web-based education does not have any effect on PEoU of technological devices Chen et al. (2013) found that university students' perceived ENJ from web-based education had a positive effect on their PEoU and PU. Sahin and Shelley (2008) found a positive and significant relationship between perceived ENJ of students in distance education process and their PEoU of distance education systems. According to Abdullah et al. (2016), in the e-learning process, a high level of perceived ENJ ensures better learning and to adopt e-learning. Looking at the results of previous studies, it may be said that the ENJ

individuals perceive from distance education systems is an intrinsic motivation source that has a positive effect on PEoU and PU.

COMPUTER ANXIETY (CA)

CA is defined as individuals' fear of the necessity or possibility of using a computer. More precisely, CA is expressed as emotional fear, anxiety, and phobia that people feel when they interact with or think about using a computer (Chua et al., 1999). In a study, conducted by Calisir et al. (2014) and Karaali et al. (2011) there are findings that employees' anxiety about using web-based learning systems negatively affects their perceptions of ease of use. Moreover, the findings of a study by Liu (2010) showed that CA was not a significant predictor of PEoU or PU. It may be said that CA will make things difficult for students in the process of acquiring the habit and proficiency of using computers. However, it is known that the computer as a technological device is mostly preferred by students for distance education during the COVID-19 epidemic (Aydemir et al., 2012; Yilmaz-Ince et al., 2020). According to Abdullah et al. (2016), CA level of students is one of the most basic determinants of their PEoU. Similarly, Rizun and Strzelecki (2020) determined that university students' CA negatively affects their PEoU of distance education systems. Similarly, Rezaei et al. (2008) in Iran and Shen and Eder (2009) in the USA concluded that there is no significant relationship between students' CA and their PEoU.

EXPERIENCE (EXP)

EXP can be defined as all of the knowledge and skills that individuals acquire in a certain period of time or throughout life. In literature, there are numerous studies examining the relationship of EXP with technological tools with ease of use and usefulness of these tools, or the effect of EXP on PEoU and PU. For instance, Igbaria et al. (1995) stated that the EXP of using computers has a direct effect on PEoU and PU. DeSmet et al. (2012) indicate that individuals' computer EXP has a positive effect on their PEoU. In addition, Davis et al. (1989) found a positive relationship between the participants' technological system experience scores and their PEoU of use from the technological system. Similar results were obtained in studies conducted with students. Tsai et al. (2021) reported a close relationship between students' EXP and their participation in live courses. In this sense, active participation is a significant indicator of effective online learning. Therefore, students need to focus on new learning EXP and get rid of prejudices, and so they can learn through their EXP (Kolb, 2015). Abdullah et al. (2016) determined that students' EXP with a technological system has a positive effect on the ease of using the system and the usefulness of the system. Similarly, Lee et al. (2013) found that students' experiences with e-learning systems have a positive effect on their PEoU and PU.

Regarding that individual experience has a positive effect on PEoU, it may be said that the results of studies examining the relationship between personal experience and PEoU and PU differ. Abbad et al. (2009), in their study with students, found that the effect of students' internet EXP on PEoU was significant, but it did not have a significant effect on PU by students. In research conducted by Abdullah et al. (2016) and Lee et al. (2011) the results show that EXP does not have a significant effect on PU. In a similar study by Pituch and Lee (2006), it was concluded that internet EXP is not a significant predictor of PU. In addition, Rezaei et al. (2008) found that internet EXP was not a significant predictor PEoU. Similarly, Lau and Woods (2008) concluded that computer EXP did not have a significant effect on students' PEoU and PU of computer-based learning tools.

PERCEIVED EASE OF USE (PEoU)

Davis et al. (1989) define PEoU as the degree to which a potential user thinks using a particular system is effortless. In other words, it is the relatively easy acceptance and adoption of a technology by individuals (Liu et al., 2009). Features of a system, such as menus, icons, and touchscreen capability, aim to increase the usability of technology. PEoU, as well as the qualities of technological systems, is an issue that users care about because ease of use can be effective in individuals' adoption, use or

intention to use a system or technology (Davis, 1989). In numerous studies (e.g., Lee et al., 2014; Liu, 2010; Venkatesh & Davis, 1996, 2000) the results reveal that the PEoU regarding technological tools has a positive effect on individuals' intention to use these tools. According to Liu et al. (2009), there is a positive relationship between individuals' PEoU about technological devices and their attitudes towards using these devices. The PEoU by individuals regarding a technological system positively affects their intentions and behaviors towards using that system (Abdullah et al., 2016; Chen et al., 2013; Lau & Woods, 2008; Lee et al., 2011; Wu et al., 2013). In this context, it may be said that the PEoU for distance education technology positively affects students' willingness to participate in distance education (Aydemir et al., 2012). Moreover, in different studies a positive relationship was found between university students' PEoU of e-learning systems and their intention to use it (Al-Gahtani, 2016; Pituch & Lee, 2006; Rezaei et al., 2008). In addition, Farahat (2012) found PEoU related to online learning is a determinant of university students' attitude towards learning.

During COVID-19 pandemic process, university students had to access distance education through technological systems. In this process, the fact that the education platform offered by the institutions to the students is without alternative makes the ease of use of the distance education system much more important. This is because the PEoU of a system is an indicator of its actual use (Rizun & Strzelecki, 2020). On the other hand, PEoU also increases the lecturers' intention to use web-based learning systems (Motaghian et al., 2013). In some studies, there are findings that there is no significant relationship between the participants' PEoU of technological systems and their intention to use these technologies. (Shen & Eder, 2009). However, the results of some studies (e.g., Purnomo & Lee, 2013; Wang & Wang, 2009) show that PEoU of a technological system has no effect on the intention to use of it. In addition, Hu et al. (1999) found that the PEoU regarding the technological system was not a significant predictor of participants' attitude towards learning.

PERCEIVED USEFULNESS (PU)

PU is expressed as individuals' thoughts about whether a technological system they use while performing their duties facilitates their work and increases their job performance compared to alternatives. In other words, it is the degree to which a potential user sees a particular technology as more valuable than alternative methods that perform the same task (Davis et al., 1989) or accepts it as being superior (Liu et al., 2009). According to Davis et al. (1989), PU is a potential user's subjective belief that using a particular system is likely to improve job performance in an organizational context. Davis (1989), who explains the relationship between the usefulness of distance education systems and the PU of the users, states that the PU is closely related to the adoption or acceptance of a technological system. The PU of a particular technology is a determinant factor of whether or not that technology is used (Liu et al., 2009). In addition, PU may increase depending on the usage time of the technological system. In this sense, the increase in the perception scores of individuals that a technological system is useful positively affects their intention to use a technological system (Davis et al., 1989).

In different studies, a positive relationship was found between PU of a technological system, web-based learning or e-learning system tools and individuals' intentions and attitude towards using the system (Aypay et al., 2012; Ozer et al., 2010; Purnomo & Lee, 2013). Literature review showed that there were numerous studies include findings, that the PU of individuals from e-learning system tools positively affected their attitudes and behaviors towards using web-based learning applications, technological systems or information technologies (e.g., Chen et al., 2013; Calisir et al., 2014; Hu et al., 1999; Lau & Woods, 2008; Lee et al. 2013; Lee et al., 2011; Liu, 2010; Liu et al., 2009; Shen & Eder, 2009; Shyu & Huang, 2011; Venkatesh & Davis, 1996, 2000; Wu et al., 2013; Yang, 2005). Moreover, similar findings were found in studies conducted with students and teachers. These studies show that the PU of e-learning systems has a positive effect on students' attitudes towards using, adopting and actually using the system (e.g., Abbad et al., 2009; Al-Gahtani, 2016; Lee et al., 2014; Motaghian et al., 2013). There are also studies in the literature, which found that the PU of students from distance

education positively affects their intention to use distance education tools and their attitudes towards using them (Liu et al., 2009; Rizun & Strzelecki, 2020). Farhat's (2012) study included the finding that there is a positive relationship between students' PU from online learning and their attitudes towards learning. In addition, Pituch and Lee's (2006) study included the findings that students' PU of distance education system positively affect their adoption or use of distance education. In conclusion, it may be said that students' PU positively affects their intention to use a technological system. However, the results obtained from some studies show that the PU does not have a significant effect on the attitude towards using the distance education system. Lee et al. (2013) found that PU has no effect on the attitude towards using the distance learning system. Similarly, Efiloğlu-Kurt's (2015) study includes the findings that the PU of university students does not have a significant effect on their behavior of actively using the distance education system.

INTENTION TO USE (ITU)

According to Liu et al. (2009) ITU is the degree to which users decide to adopt or use a technology. In the present study, the concept of ITU is expressed as the degree of willingness of students to adopt or continue using a particular distance education system. The nature of the distance education system and its modules affect the ITU a system and its modules. It may be said that students' willingness to use distance education tools has a positive effect on their behavior of actually using distance education tools (Rizun & Strzelecki, 2020). Ozer et al. (2010) found a positive relationship between the ITU the distance education system and the behavior to actually use it. There are also studies in the literature including the findings that the ITU technology positively affects the behavior of using technology (e.g., Liu, 2010; Venkatesh & Davis, 2000). Moreover, the results of some studies (e.g., Al-Gahtani, 2016; Motaghian et al., 2013; Wang & Wang, 2009) show that participants' ITU a web-based system has a positive effect on their actual use behavior.

ATTITUDE TO USE (ATU)

In this study, the attitude towards using is considered as the attitude of university students towards using the distance education system. In this context, the attitude towards use is expressed as the degree to which university students adopt and use the distance education system. Liu et al. (2009) defines attitude towards use as the degree to which participants enjoy using technology. Both PU and PEoU are shown among the main determinants of their attitudes towards the use of distance education. In studies conducted by Aypay et al. (2012) and Ozer et al. (2010), a positive relationship was found between university students' intentions to participation distance education and their attitudes to use distance education tools. According to Farahat (2012), attitude towards use is one of the factors that play the most determining role on students' distance education behaviors. In the research conducted by Karaali et al. (2011) and Lee et al. (2013), the results reveal that students' attitudes towards distance education have positive effects on their ITU a web-based learning system. Similarly, Lau and Woods (2008) found that students' behavioral intentions towards distance education systems had a positive effect on their AU behaviors.

ACTUAL USE (AU)

In current study, AU was discussed in the context of a student's behavior in actually using the distance education system. TAM claims that the ease of use of technology affects the AU of a technology-related system. In addition, the factors such as the PU of a technological system, the PEoU of the system, the attitude and behavioral intentions of individuals to use the technological system play a decisive role on the adoption and AU of a technological system (Shyu & Huang, 2011; Tao, 2009). For example, Rizun and Strzelecki (2020) found a positive relationship between university students' ITU of the distance education system and their AU behavior. In this context, it may be said that students' PEoU has a significant effect on their adoption and use of distance education. Lee (2010) argues that the ease of using distance education systems and the usefulness of the system has a positive effect on the adoption level of students ITU and satisfaction with the system. Although it was

decided to switch to distance education due to the Covid-19 outbreak, lecturers who were not ready for the functioning of distance education and face difficulties seemed less willing to distance education (Hilli, 2020). Similarly, in study conducted by Sari and Nayir (2020) the participants reported that they were not ready for the distance education process, teachers and students had difficulties in using the system and therefore they have difficulty in following the lesson.

RESEARCH AIM AND QUESTIONS

Due to the COVID-19 epidemic, education at universities in Türkiye and other countries was carried on through technological tools and web-based systems. It may be said that this process has both positive and negative effect on the development of students. Thanks to the technological tools and applications used in the distance education process, the opportunity to easily communicate with the instructors, and watch the live lesson recordings are among the positive effects of the system. However, research results showed that distance education was not effective as the face-to-face education (Yilmaz-Ince et al., 2020). Moreover, Keskin and Ozer-Kaya (2020) found that university students quickly forgot what they learned and experienced technical problems during distance education. Educational disruptions and school closures during the COVID-19 pandemic have become a remarkable social issue, particularly among the developing countries. Ample literature has verified the adverse effects of the long-lasing epidemic on school education (Ali, 2020; Izgı-Onbaşılı & Sezginsoy-Şeker, 2021; Kedraka & Kaltsidis, 2020; Keskin & Ozer-Kaya, 2020; Sakka, 2022; Sari & Nayir, 2020; Simamora, 2020; Yaylak, 2022). However, limited studies seek to understand the association between the severity of COVID-19 and effective use of distance education tools as an alternative education model (Li et al., 2022). In this sense, it is predicted that determining the tendency of university students to prefer distance education applications in the context of TAM will fill the gap in the literature and provide scientific to policy makers and practitioners in higher education.

In this study, it was aimed to determine the attitude of students at state universities towards the effective use of distance education tools during the COVID-19 pandemic in Türkiye. In this context, the aim was to determine the relationship between SE, ENJ, attitude and perceptions about CA and EXP and PEoU and PU of the distance education system of students. For this purpose, answers to the following questions were sought:

- Do university students' perceptions related to the TAM differ significantly in terms of gender, program, experience, and frequency of use?
- Is there a correlation between SE, ENJ, CA, EXP, PEoU, and PU regarding distance education?
- Do the PU and PEoU of distance education system has a determinant effect on ITU the distance education system and attitude towards using it?
- Are the intentions and attitudes of students towards using the distance education system predictive of their AU of it?

METHOD

RESEARCH MODEL AND HYPOTHESES

This study was carried out within the scope of TAM, and the relational survey model, which is one of the quantitative research designs was adopted. The Technology Acceptance Model attempts to explain and predict what the determinants of individuals' behavior towards a particular technological system are. The TAM model proposes two basic attitudes including PU and PEoU, to determine the usefulness of a technology. According to Liu et al. (2009) PU indicates the extent to which the potential adopter perceives the target technology as better and worth using compared to alternative methods to accomplish the same task. In this study, the perceptions of associate and undergraduate students attending their education at state universities in Türkiye regarding distance education during the

COVID-19 epidemic were analyzed within the scope of TAM. In addition, the effects of distance education applications on development of university students were determined. In Figure 1, the hypotheses and research model were given.

The hypotheses given below were developed by reviewing the relevant literature about the TAM model.

H1: EXP, ENJ, and SE have positive effects on the PU of distance education.

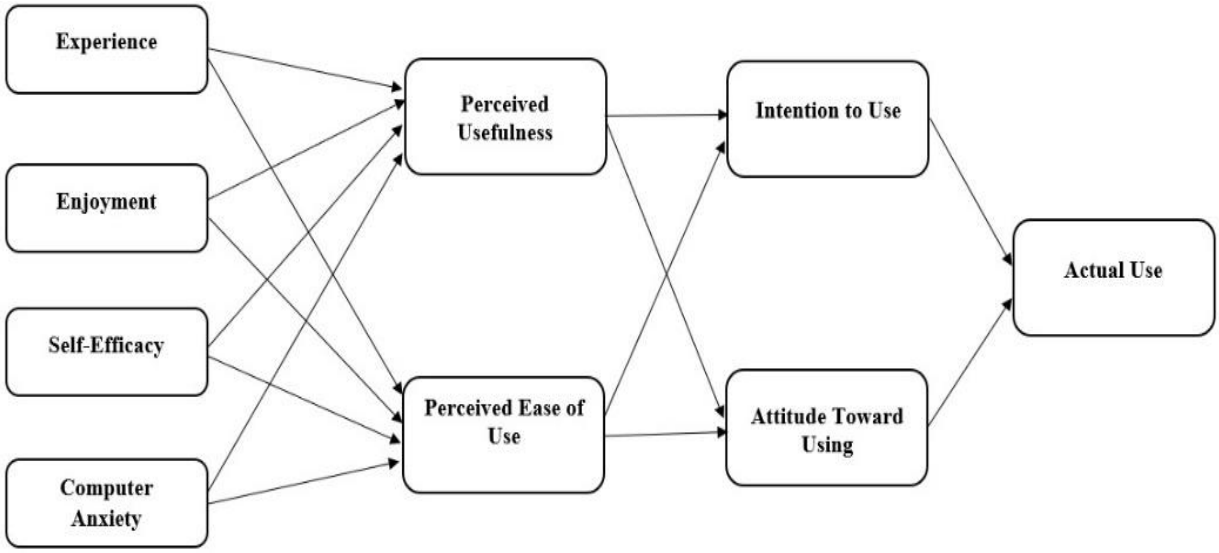
H2: CA has a negative impact on the PU of the distance education system.

H3: EXP, ENJ, and SE have positive effects on the ease of use of distance education.

H4: The PU and ease of use of the distance education system positively affect the intention and attitude of university students to use distance education.

H5: University students' ITU distance education and their attitude towards using it affect their AU of distance education positively.

Figure 1. *Research Model*



PARTICIPANTS

The population of this research consisted of university students studying at state universities in Türkiye. The number of students continuing their education at state universities in the 2021-2022 academic year is 7,616,360. The sampling group was determined by using the convenient sampling method among the students who attended 80 different state universities during the 2020-2021 academic year. The sample group was determined as 4,145 with 2% margin of error, 99% confidence level and 5% estimated response rate. So, the sample for this study was 4,118 associate and undergraduate students. Participants were determined based on the two criteria. The first criterion was that the participants should be associate or undergraduate students enrolled in formal education. The second was that the participants should be the students who used distance education systems during the period when distance education continued, and the data were collected. The aim in determining these criteria was to reach a data set that reflects more accurate and original views about distance education. The demographic characteristics of the sampling group were given in Table 1.

Table 1. *Demographic Characteristics of Sampling Group (N=4.118)*

Gender	*N*	*%*
Female	2977	72.3
Male	1141	27.7
Program	*N*	*%*
Associate's degree	1904	46.2
Bachelor's degree	2214	53.8
Experience Using Distance Education	*N*	*%*
For the first time this term	530	12.9
For the second time in this term	1775	43.1
For the third time in this term	1813	44.0
Frequency of Using Distance Education	*N*	*%*
Only during online course hours	1.984	48.2
1-5 hours every weekday	942	18.4
6-10 hours in total per week	508	12.3
11-15 hours in total	378	9.2
16 hours or more per week	488	11.9

DATA COLLECTION TOOL

The TAM Scale was used as a data collection tool. TAM Scale developed by Rizun and Strzelecki (2020) and adapted to Turkish by the researchers. The fit indices were calculated by the researchers. Accordingly, it was calculated as CFI=.93, TLI=.92, RMSEA=.07. The scale includes 30 items of five-point Likert type. The Scale has nine sub-dimensions: Self-Efficacy (3 items), Enjoyment (3 items), Computer Anxiety (4 items), Experience (4 items), Perceived Ease of Use (4 items), Perceived Usefulness (4 items), Intention to Use (3 items), Attitude Towards Use (4 items) and Actual Use (1 item). The fit indices of the TAM scale in the original study were not included. Cronbach Alpha internal consistency scores were calculated for the sub-dimensions. These scores were α=.88 for ATU; α=.89 for CA; α=.94 for ENJ; α=.87 for ITU; α=.88 for PEoU; α=.93 for PU; α=.93 for SE, and α=.87 for XP. The Cronbach Alpha internal consistency scores for this study were α=.86 for ATU; α=.86 for CA; α=.96 for ENJ; α=.93 for ITU; α=.87 for PEoU; α=.95 for PU; α=.91 for SE, and α=.86 for XP. This value shows that the internal reliability level of the TAM Scale is quite high. Data were collected electronically between 25.09.2022 and 25. 01.2023. During the data collection process, a letter was written to state universities by the second researcher, ethics committee permission and data collection tools were sent. In addition, the faculty secretaries of the education faculties were reached via e-mail, and they were asked to support the study.

DATA ANALYSIS

Data were analyzed by using IBM SPSS 25.0 statistical package program. Skewness and kurtosis values were determined to reveal whether the data was distributed normally or not. In this study, the skewness and kurtosis values for the data range from -1.5 to +1.5. These results revealed that the distribution of data was normal across the variables (Tabachnick & Fidell, 2014). Demographic characteristics of the participants were presented by using descriptive statistics such as percentage and frequency. Independent t-test and ANOVA test were used to determine whether the technology acceptance scores differed according to the demographic characteristics of the participants. The relationship between the variables was calculated by using the Pearson correlation coefficient method. Tests related to the hypotheses were carried out by using multiple regression analysis.

FINDINGS

Table 2 shows the results regarding the level of differentiation of participant views in terms of demographic variables within the scope of TAM.

Table 2. *The TAM Scores Regarding Demographic Variables (N=4.118)*

Variable	*Category*	*N*	*Mean*	*SD*	*SE*	*df*	*F*	*t*	*p*
Gender	Female	2.977	2.99	.773	.0141	4.116	36.970	1.565	.000*
	Male	1.141	3.04	.862	.0255				
Program	Associate's degree	1.904	2.96	.829	.0189	4.116	13.642	3.393	.000*
	Bachelor's degree	2.214	3.04	.777	.0163				
Use	First time	530	2.91	.866	.0376	4.117	5.016	-	.007
	Second time	1.775	2.99	.800	.0190				
	Third time	1.813	3.04	.775	.0182				
FoU*	During online course	1.984	2.79	.771	.0173	4.117	98.178	-	.000*
	1-5 hours every weekday	334	2.92	.764	.0370				
	6-10 hours in total per week	426	3.20	.723	.0396				
	11-15 hours in total	886	3.26	.724	.0243				
	16 hours or more per week	488	3.37	.830	.0376				

FoU= Frequency of Use.

As may be understood from Table 2, the technology acceptance scores have a statistically significant difference in terms of the gender variable. Independent t-test results revealed that male students' technology acceptance scores (*M*=3.04) were higher than female students (*M*=2.99). According to these results, it may be said that male students more adapt to technology and accept technology at a higher level compared to female students. Technology acceptance scores show a statistically significant difference according to the type of program. Compared to students with associate degree (*M*=2.96), students with bachelor's degree have higher technology acceptance scores (*M*=3.04). These results revealed that the adaptation and acceptance level of technology among students with bachelor's was higher than students with associate degree. ANOVA results revealed that the technology acceptance scores of the participants did not show a statistically significant difference in terms of experience of using distance education. In addition, ANOVA results revealed that the technology acceptance scores of the participants differed statistically in terms of the frequency of using distance education. Technology acceptance scores of participants who use distance education more than 16 hours a week are higher than the other participants. These results indicate that as the duration of distance education use increases, technology acceptance scores increase.

Table 3 shows the results of the correlation analysis.

Table 3. *Correlation Analysis Results*

	Mean	***SD***	*AU*	*ITU*	*ATU*	*PU*	*PEoU*	*EXP*	*ENJ*	*SE*	*CA*
AU	**3.52**	**1.31**	1.00								
ITU	**3.46**	**1.27**	.762**	1.00							
ATU	**2.62**	**1.28**	.535**	.573**	1.00						
PU	**2.33**	**1.29**	.570**	.604**	.786**	1.00					
PEoU	**3.23**	**1.14**	.642**	.636**	.616**	.641**	1.00				
EXP	**3.20**	**1.17**	.668**	.650**	.595**	.613**	.783**	1.00			
ENJ	**2.34**	**1.38**	.559**	.611**	.801**	.804**	.655**	.666**	1.00		
SE	**3.54**	**1.26**	604**	.592**	.465**	.485**	.674**	.709**	.511**	1.00	
CA	**3.27**	**1.27**	-.423**	-.445**	-.674**	-.581**	-.540**	-.588**	-.666**	-.461**	1.00

** *p<.01*

Actual Use (AU); Intention to Use (ITU); Attitude Toward Using (ATU); Perceived Usefulness (PU); Perceived Ease of Use (PEoU); Experience (EXP); Enjoyment (ENJ); Self-Efficacy (SE); Computer Anxiety (CA)

Given in Table 3 correlation analysis results showed that, there was a statistically significant and positive relationship (p<.01) between perceptions of EXP, ENJ, and SE of university students and the perceived benefit from distance education and perceived ease of use. A moderate positive

correlation was found between EXP and PU (r=.613, p<.01) and a high positive correlation was present between EXP and PEoU (r=.783, p<.01). In addition, a positive correlation was found between perceived ENJ and PU at a high level (r=.804, p<.01) and between perceived ENJ and ease of use at a moderate level (r=.655, p<.01). A moderate positive correlation was found between SE and PU (r=.485, p<.01) and a moderate positive correlation was present between SE and PEoU (r=.674, p<.01). Moreover, there is a moderate negative correlation between CA and usefulness from distance education perceived by students (r=-.540, p<.01). A moderate negative correlation was found between CA and ease of use of distance education (r=-.581, p<.01).

A statistically significant and positive relationship was found between the PU and PEoU scores for distance education, and the ITU distance education and the attitude towards using it. A moderate correlation was found between PU and the ITU (r=.604, p<.01). On the other hand, a high level (r=.786, p<.01) positive correlation was found between PU and ATU. In addition, a moderate (r=.636, p<.01) positive relationship was found between PEoU and ITU. Moreover, a moderate positive correlation was found between PEoU and ATU (r=.616, p<.01). PU and PEoU of distance education play a decisive role on the ITU and ATU of distance education systems. According to these results, it may be asserted that distance education has an important role on development of university students, who are potential human resources in Türkiye.

A high level (r=.762, p<.01) positive correlation was found between ITU and AU scores. Moreover, a moderate positive correlation was found between ATU and AU scores (r=.535, p<.01). The findings indicated that university students' ITU of distance education and their attitudes towards using it predict their AU scores at a high level. AU, ITU, ATU, SE scores revealed that distance education has a significant effect on development of the university students. According to these results, it may be asserted that distance education is highly beneficial for development of university students as the potential human resources.

Table 4 shows the results of regression analysis regarding the research hypotheses.

Table 4. *Regression Analysis Results*

Model 1	B	SE	β	t	p	Tolerance	VIF
Dependent Variable: PU							
Constant	.480	.078	-	6.169	.000	-	-
XP	.109	.017	.099	6.502	.000	.359	2.783
ENJ	.643	.013	.684	49.858	.000	.441	2.268
SE	.045	.013	.043	3.346	.001	.494	2.026
CA	-.049	.013	-.048	-3.775	.000	.518	1.931
R^2= .659	Adjusted R^2=.658		$F_{(4,41)}$ = 1985.493	p=.000 < .01; Durbin-Watson=1.971			
Model 2	B	SE	β	t	p	Tolerance	VIF
Dependent Variable: PEoU							
Constant	.673	.068	-	9.930	.000	-	-
EXP	.463	.015	.474	31.713	.000	.359	2.783
ENJ	.179	.011	.216	15.993	.000	.441	2.268
SE	.200	.012	.220	17.252	.000	.494	2.026
CA	-.014	.011	-.016	-1.272	.204	.518	1.931
R^2= .670	Adjusted R^2=.669		$F_{(4,41)}$ = 2083.283	p= .000< .01; Durbin-Watson= 1.908			
Model 3	B	SE	β	t	p	Tolerance	VIF
Dependent Variable: ITU							
Constant	1.173	.043	-	27,070	.000	-	-
PU	.328	.015	.334	22.586	.000	.590	1.696
PEoU	.470	.016	.423	28.609	.000	.590	1.696
R^2= .470	Adjusted R^2=.470		$F_{(2,41)}$ = 1828.210	p=.000<.01; Durbin-Watson= 1.847			
Model 4	B	SE	β	t	p	Tolerance	VIF
Dependent Variable: ATU							
Constant	.386	.036		10.708	.000		
PU	.660	.012	.664	54.496	.000	.590	1.696
PEoU	.214	.014	.191	15.634	.000	.590	1.696
R^2= .640	Adjusted R^2=.639		$F_{(2,41)}$ = 3650.415	p=.000<.01; Durbin-Watson= 1.933			
Model 5	B	SE	β	t	p	Tolerance	VIF
Dependent Variable: AU							
Constant	.702	.039	-	18.202	.000	-	-
ITU	.701	.013	.678	56.001	.000	.672	1.489
ATU	.149	.012	.146	12.044	.000	.672	1.489
R^2= .595	Adjusted R^2=.594		$F_{(2,41)}$ = 3018.514	p=.000<.01; Durbin-Watson= 1.963			

As may be understood from Table 4, EXP, ENJ, SE, and CA has a statistically significant effect on PU of distance education [$F_{(4.41)}$ = 1985,493; R2=.658; p<.01]. In Model 1, multiple linear regression analysis results revealed that EXP (β=.099p<.01), ENJ (β=.684; p<.01), and SE (β= .043; p<.01) has positive effect on PU, but CA has a negative effect (β= -.048; p<.01).

In Model 2, EXP, ENJ, and SE has a statistically significant and positive effect on the PEoU of distance education systems [$F_{(4.41)}$ =2083,283; R2=.658; p<.01]. EXP (β=.474; p<.01), ENJ (β= .216; p<.01), and SE (β= .220; p<.01) has positive effect on PEoU. It is seen that CA does not have a significant effect on PEoU (p>.01). According to Model 3 and Model 4, PU is a determinant variable for the ATU (β= .664; p<.01) and the ITU (β=.334; p<.01). In addition, PEoU affects positively ATU (β=.191; p<.01)

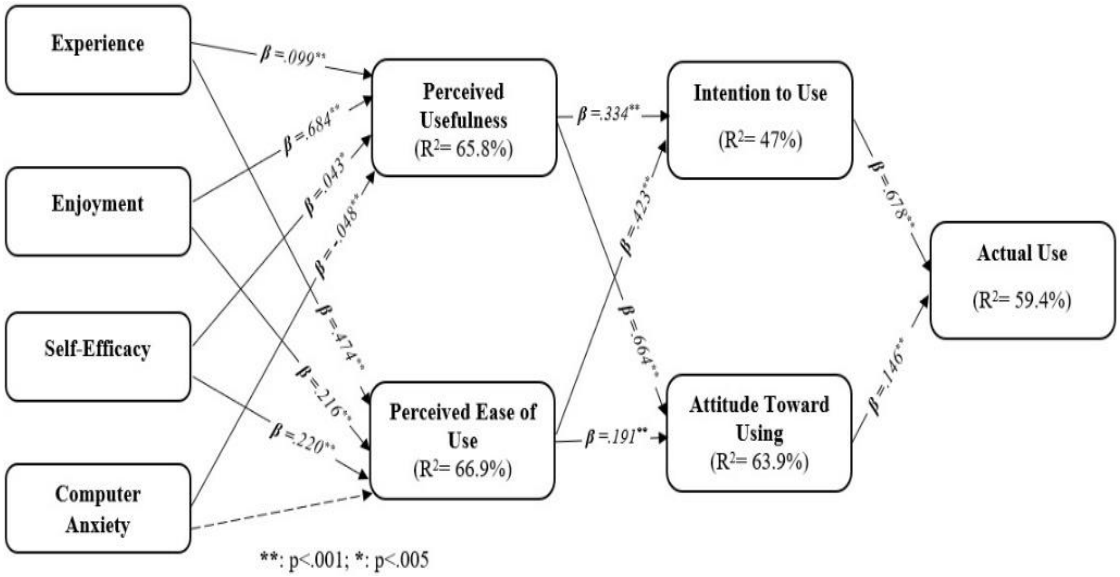
and ITU (β=.423; p<.01). Regarding these results, it may be said that the usefulness of distance education has a positive effect on ITU and ATU.

In Model 5, ITU (β= .678; p<.01) and ATU (β=.146; p<.01) has positive effect on AU. ITU and ATU explain 59.4% of the variance regarding the AU [$F_{(2.41)}$ = 3018,514; R2=.594; p<.01]. These results show that ITU and ATU broadly affects AU.

RESULT MODEL

In Figure 2, the result model related to the hypothesis tests of the research was presented.

Figure 2. *Result Model*



As explained in Figure 2, EXP, ENJ, and SE has positive effect on PU. These results revealed that the H_1 hypothesis was confirmed. CA has a significant and negative effect on PU. These results indicated that the H_2 hypothesis was confirmed. In addition, EXP, ENJ, and SE has positive effect on PEoU. These results revealed that hypothesis H_3 was confirmed. PU and PEoU has positive effect on ITU and ATU. According to these results, the H_4 hypothesis was confirmed. It was determined that ITU and ATU has positive effect on AU. These results revealed that the H_5 hypothesis was confirmed.

DISCUSSION

This research aims to determine the attitude of students at state universities towards the effective use of distance education tools during the COVID-19 pandemic in Türkiye. The variables such as EXP, ENJ, SE, CA, PEoU, PU, ITU, ATU, and AU were considered to determine the attitude and perceptions of undergraduate students towards distance education. In this context, the relationship between variables was determined by using correlation analysis technique and the hypotheses were tested by using multiple linear regression analysis.

The results showed that male participants reported higher technology acceptance scores than female participants. It may be said that the fact that male participants have fewer problems in accepting and using technology than females is effective in the emergence of this result. In literature, numerous studies revealed that male participants reported a higher level of acceptance scores and tendency to use technology compared to women. Venkatesh et al. (2003) found that females were more anxious than males when it comes to IT utilization and this nature of females reduced their SE, which in turn led to increased perceptions of the effort required to use IT. Similarly, Venkatesh and Morris (2000) found that women perceived lower-level ease of use because they reported higher level

of CA when compared to their male counterparts. The students with bachelor's degree reported higher technology acceptance scores than students with associate degree. In addition, as the duration of using distance education increases, technology acceptance scores also increase. Regarding these results, it may be asserted that the students with bachelor's degree benefit more from distance education practices during the Covid-19 process. Moreover, the results showed that as the duration of using the distance education system increases, the system provides more benefits for the development of university students. These results are consistent with the findings of previous studies. De Smet et al. (2012) assert that EXP has a positive effect on PEoU. Similarly, Igbaria et al. (1995) state that the EXP of using a computer has a direct effect on PEoU and PU. In a study conducted by Yaylak (2022), the participants reported the use of technology in education as indispensable to continue of education during COVID-19 pandemic. However, they reported that the lack of interaction in distance education, digital impossibilities, and psiko-social factors were the negative aspects. The participants also emphasized that rather than being adequate, distance education was inadequate due to interaction- and infrastructure-related issues.

The results revealed a strong positive relationship between the EXP, ENJ, SE, PU, and PEoU perception scores of university students. However, CA has a negative effect on PU and PEoU. This result may be due to the fact that university students have not tablet computer or PC. It may be said that this negatively affects the academic development of university students by reducing the PU and PEoU scores of distance education during the COVID-19 pandemic. Numerous studies include findings that are consistent with these results. Igbaria et al. (1995) found that the experience of using a computer has a positive effect on PEoU and PU. Moreover, Park et al. (2012) found that ENJ has a positive effect on PU of web-based education. In another study conducted by Igbaria and Livari (1995), technological SE has a positive effect on computer use. Similarly, in Liaw and Huang's (2013) study, technological SE is a significant factor for PEoU and PU of e-learning environments. On the contrary, in Sari and Nayir's (2020) study, the participants reported that they were not ready for the distance education process and there was a lack of technology support and distance education training. Moreover, the participants stated that they did not have sufficient knowledge and experience about distance education.

In this research, another remarkable result is that the PU and PEoU of distance education has a decisive effect on the ITU and ATU of distance education systems. Similar findings were found in previous studies. In a study conducted by Rizun and Strzelecki (2020), the results revealed that university students' PU and PEoU of distance education during the COVID-19 pandemic decisively affected their intention and attitude to use distance education systems. These results show that distance education has an important role in the academic development of university students during the COVID-19 pandemic in Türkiye. On the contrary, in a study conducted by Ocak and Sahin (2021), participants declared lower proficiency levels in their learning goals. In addition, they reported lower scores especially in practical training results during distance education. Conversely, student academic grades were higher in the distance education group. Moreover, there were serious difficulties in measurement and evaluation methods in distance education.

The results also revealed that EXP, ENJ, SE, and CA has a significant effect on PU and PEoU. According to these results, it may be asserted that reducing computer anxiety, eliminating problems in accessing the system and strengthening students' self-efficacy perceptions will play a significant role in ensuring the effective development of university students through distance education. Although the findings of this study are completely unique, it is possible to see similar findings in previous studies. Abdullah et al. (2016) found that EXP, ENJ, and SE perceptions of participants affected PU and PEoU. Similarly, Rizun and Strzelecki (2020) found that the EXP, ENJ, and SE perceptions of university students affected the PU and PEoU during the COVID-19 pandemic. Chen et al. (2013) found a positive correlation between perceived enjoyment and perceived usefulness of distance education. Computer anxiety has not a statistically significant effect on perceived usefulness of distance education. This result is consistent with the results of studies conducted by Liu (2010), Rezaei et al. (2008), Rizun and

Strzelecki (2020), and Shen and Eder (2009), but it is not consistent with studies conducted by Abdullah et al. (2016), Calisir et al. (2014), and Karaali et al. (2011).

The results revealed that PU and PEoU was a significant determinant for the ATU and ITU. These results show that distance education is perceived as useful and easy to use during the COVID-19 pandemic, and it has a positive contribution to development of the university students. In literature, numerous studies have findings that the PU and PEoU is the determinant of ATU and ITU distance education. In studies conducted by Abdullah et al. (2016), Calisir et al. (2014), Farahat (2012), Lee et al. (2013); Liu et al. (2009), Rizun and Strzelecki (2020), and Weng et al. (2018), PU and PEoU is predictive variable for attitude towards using distance education and intention to use it.

ITU and ATU has positive effect on AU of distance education system. Based on these results, it may be considered that distance education is an indispensable application for academic development of university students during the COVID-19 pandemic. In a number of studies (e.g., Al-Gahtani, 2016; Davis et al., 1989; Farahat, 2012; Lau & Woods, 2008; Liu, 2010; Motaghian et al., 2013; Ozer et al., 2010; Wang & Wang, 2009) ITU and ATU has positive effect on AU of distance education systems. As a result, if used properly, technology can help students succeed academically and prepare them for subsequent online learning and within the future. In reality, it's not enough to only offer online learning opportunities to students to offer them accessibility and adaptability (Simamora, 2020). Actually, the shutting down of schools has widened learning inequalities and has harmed the education chances of students around the world, especially in low-income developing countries, where the resources of education are quite limited and education inequality are more common (Li et al., 2022). Therefore, lecturers must remember to still connect the advantages of studying and training online with students.

CONCLUSION AND IMPLICATIONS

In conclusion, PU and PEoU of distance education is a significant determinant of ATU of distance education systems. As the PU and PEoU of distance education system increases, the ITU and AU behavior increases. These results indicated that during the COVID-19 pandemic, distance education systems were indispensable implementation for academic development of university students in Türkiye. Moreover, both digital technologies and traditional medias can be implemented to enhance the possibilities of carrying out distance learning.

This quantitative research includes a broad observation, which higher education institutions in Türkiye faced because of the COVID-19 pandemic since March 2020. Based on the example of different universities, this study provides a full picture of effective use of distance education tools in higher education. However, qualitative research on the current case will provide more functional and in-depth empirical data and contribute more by sharing the real experiences of university students. Another limitation of this study that can be criticized by readers is the indirect examination of the effect of distance education on the development of university students as a potential human resource during the COVID-19 pandemic process within the scope of TAM. To overcome this, in-depth interviews with a more specific working group to be determined with the targeted sampling method would be beneficial. However, it should be considered that the extensive quantitative research cannot be carried out easily during the COVID-19 pandemic. These results may be beneficial for the Council of Higher Education (CoHE) to understand of undergraduate students' preferences on effective use of distance education tools in higher education. Hopefully, this results from current study may lead policy makers in education to enhance and harden strong and comprehensive online learning within the future. In addition, tablet computer may be provided to undergraduate students, and they may be supported in effective use of technology. In the light of the findings from current study, qualitative research may be conducted to achieve a deeper understanding of the topic. Although the participants stated that they use distance education tools effectively, there are doubts about the quality of the education received during the Covid-19 pandemic process. In this context, research should be conducted to determine the

effect of distance education, which is carried out during the pandemic, on the academic success and professional skills of university students.

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AUTHOR CONTRIBUTIONS

The first author contributed to the conceptual framework of the study, method, data analysis, and presentation of the findings.

The second author made significant contributions to the collection of the research data, the formulation of hypotheses, and the analysis and interpretation of the data.

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Types of Feedback in Inquiry Science Learning Classroom in Secondary Education*

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Abstract

Although an inquiry-based approach has been adopted in science lessons in recent years, the characteristics of this approach have been ignored in determining teacher feedback. In this study, it is aimed to determine teacher feedback by considering the cognitive and affective components inherent in inquiry. This study, based on qualitative research, was conducted with an instrumental case study design. The types of verbal feedback given by the teacher were followed during the inquiry-based science lessons. With the content analysis of the collected data, the feedback was classified according to their method and function. In this study, the place of the feedback types determined in the environment where inquiry-based learning is taken into account, in the literature is discussed by comparing them with the existing feedback types.

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INTRODUCTION

In recent years, science curricula have been prepared taking into account the Inquiry-based learning (IBL) approach. Students learn both how to do science and the nature of scientific inquiry in learning environments with scientific inquiry (Strippel & Sommer, 2015). Students experience the scientific process that scientists go through as they seek answers to questions about the nature. In this process, they use the skills of asking questions, designing and conducting research, using appropriate tools and techniques to collect data, thinking critically and logically about the correlation between evidence and explanations, creating and analysing alternative explanations, and communicating scientific arguments (NRC, 2012). At the same time, they learn science concepts, principles, and theories in a meaningful way (Abd-El-Khalick et al., 2004). It is necessary to examine IBL not only in terms of cognitive development in students, but also in terms of the characteristics of the social environment. Teacher feedback is one of the most important predictors of balance in the learning environment (MacIsaac & Falconer, 2002).

Feedback that directs students to competition and grades in the classroom, which is a social environment, can focus on getting high grades and being the best in the eyes of teachers and students, instead of focusing on the development of students' inquiry skills and discovery of knowledge (Jagacinski & Strickland, 2000). Feedback that directs meaningful learning, sharing, discussion, and monitoring the improvement in their own knowledge and skills focuses students on increasing their own knowledge and expertise. Teacher feedback plays a key role in creating a learning environment based on a solid cognitive and affective basis. For this reason, teacher feedback that is effective on students' cognitive and affective characteristics (Hattie, 2009; Chi, Wang & Liu, 2021) should be determined and classified by taking into consideration the characteristics of the learning environment. While making this classification, the course content, the learning approach used in the course and the affective characteristics of the students should be brought into account.

Although there are many studies in the literature in which feedback is defined and classified, in these studies, feedbacks were made for quite different lessons rather than a specific field, without considering the specific characteristics of the lesson. However, due to the nature of both science and scientific inquiry, feedback in the science lesson is expected to differ from other lessons. Feedback may lead to the continuation or discontinuation of inquiry in the lessons, the participation of the student in the inquiry process or their avoidance. For this reason, it is important to define and classify feedbacks according to science courses in which scientific inquiry is taken into account. In this study, it is aimed to identify and classify teacher feedback in inquiry-based science lessons. It is thought that this definition and classification will guide practitioners and researchers in conducting science lessons in accordance with the nature of scientific inquiry.

CONCEPTUAL FRAMEWORK

WHAT IS FEEDBACK?

In the literature, it is seen that the definition and function of feedback are closely related to learning theories. Researchers (Hattie et al., 2007; Sadler, 1989; Tunstall et al., 1996) defined learning as information provided to shape students' behaviours and close the gap between real and desired performance and understanding, and classified feedback with expressions such as punishment and praise. In this approach, feedback directly affects the learning outcome (Thurlings, Vermeulen, Bastiaens, & Stijnen, 2013) and is provided to the learner in order to analyse and organize their own cognitive patterns (Jonassen, 1991).

Considering the development of cognitive processes to the extent that students interact in appropriate experience environments, theorists have defined feedback as the communication established with the student in order to improve the learning capacity of the student. Bloom (1984) defined feedback as all the messages that the teacher presents in the learning process to support the students' work in the process of achieving their learning goals. Shute (2008), on the other hand,

defined feedback as the information presented by the teacher that aims to change the student's thoughts and behaviours about learning. He stated that this information may include the difference between the student's current performance and the targeted performance. Voerman, Meijer, Korthagen and Simons (2012) added to this definition of feedback the difference between the initial level of a performance and the current level. Feedback is a tool that shows improvement in a performance or target performance to be reached. According to the theorists who think that interaction among environment, individual characteristics and behaviour is effective on learning, aims and expectations are important source of motivation (Schunk, 2014). When teacher feedback is provided to the students according to students' learning aims, it will provide a motivation for learning. In this case, teacher feedback coming from learning environment will affect the students' learning aims. Therefore, teacher feedback gains both a cognitive and affective dimension (Wisniewski, Zierer & Hattie, 2020).

LITERATURE REVIEW

While classifying teacher feedback in the literature, there are differences in the criteria. Voerman et al., (2012) classified the feedback of Science, Mathematics, Language and other subject teachers in vocational education and high schools as specific positive feedback, nonspecific positive feedback, specific negative feedback, nonspecific negative feedback and other interventions. They divided specific feedback into progress feedback and discrepancy feedback. Progress feedback highlights the difference between initial performance and current performance. Discrepancy feedback, on the other hand, emphasizes what needs to be done, taking into account current performance, in order to reach the targeted performance level. Carless and Winstone (2020) examined teacher feedback in terms of design, relational, and pragmatics dimensions. In the first dimension, teacher feedback is designed for students to make self-assessment. In the second dimension, feedbacks were arranged by considering interpersonal relations. In the last dimension, the feedback of the teachers involved in the management of the learning process was evaluated.

Tunstall et al., (1996), on the other hand, classified the feedback given by 8 teachers teaching at primary school 1st and 2nd grade levels as descriptive, evaluative and socialization feedback. Descriptive feedback explains student behaviour and provides information on how these behaviours can be improved. Evaluative feedback reports conclusions about the student's behaviour. Socialization feedback is about classroom rules, values, and attitudes. Unlike the others, Hattie et al., (2007) also considered the task variable while classifying the feedback. Task feedback can provide information about the accuracy of a task or product, as well as instructions given to students to succeed in the task. Task processing feedback is the feedback used in the process of creating a complex task or product. This type of feedback is directly aimed at learning the process of obtaining information, processes that require understanding, or completing a task.

The number of studies in the literature that makes the identification and classification of feedbacks taking into account the nature of science lessons is limited. Özkale et al., (2021), classified the feedback in science lessons as "expressions of praise", "effort-based feedback", "negative feedback" and "ability-based feedback". Cengiz and Ayvacı (2017), on the other hand, classified teacher feedback in secondary school science lessons by considering only the feedback presented for the mistakes made by the students. His classification includes stating "wrong", giving another student the right to speak, asking the question again, giving the answer directly, explaining the answer, questioning the reason for the mistake - asking a question about the mistake, correcting-completing the missing-wrong part of the answer, giving hints-directing the student, repeating the student's answer exactly, ignoring the student's answer. On the other hand, Chalmers, MacCallium, Mowat, and Fulton (2014) examined the feedback given to the laboratory reports of students in university biology courses. These are classified as identifying errors, praising, correcting errors, explaining misunderstandings, demonstrating good practices, suggestions for future studies, approach suggestions for future studies, and justifying marks. Although feedback in science lessons has been

classified by researchers, studies that consider the nature of science lessons and scientific inquiry are limited in the literature. Chin (2006) classified teacher feedback in inquiry-based science lessons as confirming when the student gives a correct answer, focusing the student by expanding the subject with many questions about the answer when some part of the answer is correct and some part of it is wrong, explaining the answer when the student gives a wrong answer, and rejecting the student's answer by changing the question when the student gives a wrong answer. Eckes and Wilde (2019) classified the feedback given by 165 prospective biology teachers to student groups while working on the experiment in IBL settings in German secondary schools as lesson-specific informative feedback and basic feedback. The basic feedback is the teacher's superficial directions for the students to reach the result in the learning process. Informative tutoring feedback specific to the lesson is that the teacher supports the students in completing a task, homework or solving a problem in the IBL environment. Rinehart, Kuhn, and Milford (2020) categorize the dialogic feedback that 8th grade teachers present in science lessons at the kindergarten level in the USA. In lessons where argument-based inquiry method is used, dialogic feedback is defined as feedback that directs students to participate in discussion cycle. Feedback is classified as reframing, elaboration, reflection, construction, and criticism. In these studies, although the feedback was determined by considering the characteristics of scientific inquiry in science lessons, the social and affective dimensions of scientific inquiry were not considered sufficiently.

In this study, feedback was determined and classified by considering the IBL approach which based on socio-cognitive learning theory and students' achievement goal orientations in the context of science lesson.

THE IMPORTANCE OF THE STUDY

Each lesson has its own unique content and characteristics. For this reason, the feedback to be used in each lesson should be suitable for the structure of that lesson. In addition, feedback is also affected by the learning approaches adopted in the lessons. For example, a teacher who provides feedback (Rinehart et al., 2020) for students to criticize each other's ideas during argumentation-based science lessons may offer task-related feedback (Van den Bergh, Ros, & Beijaard, 2013) during active learning. Inquiry Based Science learning has conceptual, social, procedural and epistemological dimensions (Furtak, Seidel, Iverson & Briggs, 2012). For this reason, it is necessary to include these dimensions when determining the feedback in these courses. In order for the inquiry process to continue, the feedback that should be provided to a student who does the experiment incorrectly, or the feedback that should be provided to a student who has difficulty in converting the table into a graphic should be different. Examining the feedback provided during inquiry-based science lessons is important to identify feedback specific to the type of lesson and the learning approach used. Another important point is the affective characteristics of the students. Teacher feedback will affect affective properties and cognitive properties as well. This study focuses on success-goal orientation, the importance of which has been recognized in recent years. Achievement goal orientation is a theory that deals with the reasons for students' goals for the course (Dweck & Leggett, 1988). The type of feedback given by the teacher also has the potential to set students' goals.

In this study, it is aimed to determine the verbal feedback of the teacher by considering the inquiry environment in science lessons. The research problem has been determined as “What are the types of verbal feedback provided by the teacher in the IBL environment within the scope of the Science Lesson?”.

METHOD

RESEARCH DESIGN

In this study, instrumental case study, one of the qualitative research methods, was used. The case in the study is teacher feedback in the IBL environment.

STUDY GROUP

In order to determine teacher feedback in the IBL environment, the data was collected in a public school in Turkey in two classes at the 5th grade, for nine weeks (37+37 class hours) of science lessons. The total number of students in the classes is 32 (15+17). In these classes, science lessons are conducted by a teacher who has a master's degree and has seven years of experience. The teacher taught his lessons in both classes by taking the IBL into account. It is thought that the characteristics of the students who make up the learning environment, as well as the approach adopted by the teacher, will be effective on teacher feedback. For this reason, the Scientific Process Skills Test (SPST) and Achievement Goal Orientation Scale (AGOS) were applied to the observed classes in order to determine the student characteristics. Mann-Whitney U Test was conducted for science process skills, and it was determined that the students in both groups had equal scientific process skill scores (U=106.50, Z=- 0.251, P=0.802> 0.05). The Mann-Whitney U Test was also used for achievement goal orientation, and it was determined that the achievement goal orientation scores of the students in both groups were equal (U=75.50, Z=-1.538, P=0.124> 0.05).

DATA COLLECTION

In order to determine the student characteristics in the classrooms to be observed, the scientific process skill test and the achievement goal orientation scale were applied. In order to determine the types of feedback, regular observations were made in both classes, and the data were collected with lecture audio recordings and researcher lecture observation notes. In addition, observations were made with the Reformed Teaching Observation Protocol in order to determine the level of inquiry.

SCIENTIFIC PROCESS SKILL TEST (SPST)

The test was developed by Burns, Okey and Wise (1985) and adapted into Turkish by Özkan, Geban and Aşkar (1992). It is revised by Çakar (2008) considering scientific process skills that is appropriate for 5th grades. The test is composed of 24 items and KR-20 reliability for the test is calculated 0.86.

ACHIEVEMENT GOAL ORIENTATION SCALE (AGOS)

It is a 5-point-Likert type scale developed by Ames and Archer (1984) and adapted into Turkish by Demir (2011). The 33-item scale consists of performance goal orientation and mastery goal orientation dimensions. The α reliability coefficient of both sub-dimensions of the scale is 0.89. According to the results of the principal components factor analysis, the factor loads of the first component vary between 0.69 and 0.48, and the factor loads of the second component vary between 0.37 and 0.63.

CLASSROOM OBSERVATION NOTES OF THE RESEARCHER (CONR)

It is aimed to determine the feedback given by the teacher in this process with classroom observations. The researcher observed the lessons taught by the practice teacher in both classes for nine weeks. CONR consists of objective notes of teacher feedback, course content, students' experiments and activities, and discussions in study groups.

REFORMED TEACHING ORGANIZATION FORM (RTOP)

Observation form is developed by MacIsaac and Falconer (2002) to determine the level of inquiry in lessons. The form consists of 25 items and three dimensions (lesson planning and implementation, content and classroom culture). Items are scored between 0 and 4. After observing inquiry-based science lessons, a reasoned scoring is done for each item in the observation form. A maximum of 4 points can be obtained from each item of the 25-item scale. If the score of a lesson is less than 20 points, it indicates that the observed lesson is taught in a traditional way, in which students are passive. If it is lower than 45 points, it refers to traditional lessons with student questions in the lesson. If it is lower than 55 points, it indicates that most of the lecture is done by the teacher, even if

there are group studies. The 65–75-point range describes the class in which the students create their own personal response system and have a medium level of questioning. A course with a score between 65 and 99 refers to the courses with the highest level of inquiry, which varies according to the amount and quality of speeches.

VOICE RECORDINGS OF THE LESSONS

During the observations in the classrooms, a voice recorder was placed in 4 learning groups, one for each. The reason for placing voice recorders in each group is to detect the verbal feedback given by the teacher in each group.

CHARACTERISTICS OF THE LEARNING ENVIRONMENT, DATA COLLECTION PROCESS AND THE ROLE OF RESEARCHERS

Teacher feedback was determined by the researchers by following the units "Let's Solve the Riddle of Our Body", "Measurement of the Magnitude of Force" and "Change of Matter". Science lessons were conducted by the teacher in groups of 4 in each class. The teachers stated that they formed the groups according to the academic achievements of the students, and that they paid attention to the presence of students at all levels in each group. The science lesson was carried out as 4 hours a week, and the teacher also gave a guidance lesson for 1 hour every week. Within the scope of the guidance, the teacher directed all students to design experiments within the scope of their research and provided the necessary materials for the experiment they designed. At the same time, he directed the students who came without research to complete their research and design experiments until the next lesson. The teacher conducted his observed lessons at the level of open inquiry. In order to ensure questioning, the course contents used by the teacher were reviewed by researchers before each lesson and feedback was given to the teacher. The lessons were taught by the teacher according to the 5E learning model. In step 1E, a problem situation was created that students would be curious about, and the students were asked to identify the problem as a group, conduct research about this problem, collect data, and prepare an experiment or activity for the solution of the problem. After the 1E step, a guidance hour was done to support the students in designing activities or experiments in line with their research. In the 2E step, the experiments, or activities that the students prepared as a group were presented to the class and a class discussion was made. In cases where the students did not design activities or experiments, alternative activities prepared by the teacher were implemented. In the 3E stage, they made explanations and created models based on their observations and experiments. At the 4E stage, the subjects were deepened according to the achievements, and the students had the opportunity to use the knowledge and skills they acquired in the 2E and 3E stages at this stage. In the 5E stage, the students individually answered the activities prepared using the knowledge they had acquired. The questioning level of the learning environment was determined by the RTOP form. The lessons observed by the researchers were analysed according to the RTOP form and a score was created for each lesson. Thus, it was possible to comment on the inquiry level of the observed lesson. Researchers attended the lectures as unattended observers, took audio recordings of the lectures and kept lecture observation notes. After the observation, the observation notes were read to the teacher and the participant's confirmation was received. The lowest RTOP score of the observed lesson was calculated as 74 and the highest as 100. For this reason, the level of inquiry in all of the observed lessons is high.

ANALYSIS AND INTERPRETATION OF DATA

Participation in the research was carried out on a voluntary basis and ethical principles were fully complied with. Ethical permission (90864724-605-E.13527033) was obtained from the Ministry of National Education of the Republic of Turkey before the study. Before collecting data, students were informed about the study and data were collected from volunteer students.

In order to determine teacher feedback, notes and lecture audio recordings of lecture observations were analysed by content analysis. Before the research started and throughout the research process, the literature was constantly read and provided an idea about the analysis of the data. At the end of the research, all the data were brought together in written form in the computer environment and the whole of the research was seen. During the analysis process with the inductive method, the written documents were analysed separately by the researchers simultaneously. Then, the results of the analysis were compared by coming together. In the comparison, the differences in the analysis were discussed one by one and re-coded. As the analysis process progressed, the number and detail of the codes constantly changed. Before the classification and the process of reaching the themes, the meanings of some of the codes were renewed, and the codes that were determined to be irrelevant to the research were excluded from the scope of the study. The codes and themes along with sample feedbacks were presented to the opinion of two experts who had research on feedback. The themes, which were rearranged in line with the opinions of the experts, were finalized. The determined codes were placed in the finalized themes. The research question was associated with the theme, and the themes were defined and exemplified. Finally, the results reached in the qualitative data analysis process were made into a report. In order to determine the inquiry level of the learning environment, the notes of the lesson observation and the lesson audio recordings were analysed with descriptive analysis. The lessons were scored by the researchers, taking into account the criteria in the RTOP form. The researchers made the scoring independently of each other. By comparing the results with each other, the situations that disrupted the harmony were determined and the analyses were reviewed again. The results of the analysis were presented to the opinion of an expert who has studies on IBL, and it was finalized.

FINDINGS

In this section, verbal feedbacks are handled separately for each category. Verbal feedback was exemplified and explained with the help of teacher-student dialogues taken from the lesson audio recordings. There are situations where the teacher uses more than one type of feedback in the sample dialogs given. While explaining each type of feedback, all these feedbacks are given together to ensure the integrity of meaning in the dialogues, but only the type of feedback to be explained is discussed.

In this study, the feedbacks are grouped under two categories called the method and function of the feedback. These categories are also classified within themselves. Feedbacks have eight subcategories by method and four by function (Table 1).

Table 1. *Feedback Categories*

Categories of feedback	
Method	Function
Giving or not giving opportunity	Supporting the mastery goal orientation
Expressing personal negative feelings	Supporting the performance goal orientation
Foregrounding the individual or group	Continuing the inquiry process
Explaining the process	Ending the inquiry process
Reflection	
Feedback about peer relations	
Not Giving Feedback	
Comparison feedback	

FEEDBACK METHOD

The feedback method is the teacher's way of presenting feedback to students during the lesson. During the lesson, the teacher can follow different ways in communicating with the students. It may or may not allow students to express themselves, monitor their own learning, and think about different questions about the subject. He may get angry with students, bring a student to the forefront in the class as a result of his positive behaviour, direct a student to the class by repeating a thought expressed

by a student, make a statement about the learning process, or give no reaction to student behaviour. All these behaviours shown by the teacher during the lesson are within the scope of the feedback method. Feedback method: It consists of eight sub-categories as giving/not giving opportunity, expressing personal negative feelings, foregrounding the individual or group, explaining the process, reflection, peer relations, not giving feedback and comparison. Each sub-category of method feedback is presented with codes and sample dialogues belonging to the relevant category.

GIVING OR NOT GIVING OPPORTUNITY

Giving/not giving opportunity feedback is about the teacher creating or preventing a classroom atmosphere that will enable students to express themselves, to be encouraged for learning, to think, to relate to daily life. Encouragement / self-expression, self-monitoring, giving the opportunity to think and not giving the opportunity to think were used for this feedback. The teacher created learning opportunities by encouraging the students to learn and making them think about their own learning.

In table 2, teacher encouraged students to make guesses by asking questions in lines 1, 3, 5 and 7 within the scope of the discovery activity on the subject of "Measurement of the Magnitude of Force" and encouraged students to design and present an experiment or activity in line 9. In line 11, he stated that students can choose the necessary materials from the materials brought to the classroom so that they can design experiments or activities. In this way, he used the *giving opportunity feedback* six times.

Table 2. *Giving Opportunity Feedback*

Line	*Utterance*
01	*Teacher: Ayşe, which string of yours is more flexible?*
02	*the thin one.*
03	*Teacher: The thin one. 1st Group, which string of yours is more flexible?*
04	*thin.*
05	*Teacher: thin one. 3rd Group, which string of yours is more flexible?*
06	*the thin one.*
07	*Teacher: 4th Group?*
08	*thin.*
09	*Teacher: thin. Well, who can show me this with an activity, which one is more flexible?*
10	*We can show my teacher. I can show my teacher please, my teacher.*
11	*Teacher: Well then, let's sit down. Equipment is here. Look at these materials, there are green strings here. Come and see if it works for you. Show which string is more flexible.*

On the contrary, the teacher did not give the students the opportunity to learn by directly telling the deficiencies and mistakes in their studies, explaining the learning goal or the reason for the student's mistake.

Given in table 3, the teacher poses questions to the students within the scope of the evaluation activity on the subject of "Change of State". In the 1st, 3rd, 5th, 7th, 9th, 11th and 13th lines, teacher used to give opportunities feedback for students to express themselves. However, when the teacher made a wrong explanation about the concept of frosting in the 14th line, the teacher made the definition himself by interpreting the mistake in the student's answer in the 15th line. For this reason, the feedback provided by the teacher on line 15 is within the scope of *giving no opportunity feedback* in the subcategory of giving/not giving opportunity.

Table 3. *Giving No Opportunity Feedback*

Line	*Utterance*
01	*Well last question. On cold days, in the morning at work, let there be fruit or ice crystals on the grass. In fact, what do the farmers say, frost shot, right? What is this event? Yes, tell me.*
02	*frost over.*
03	*Teacher: frost over. What do you say Mehmet?*
04	*frost over.*
05	*Teacher: Selin what about you?*
06	*frost over.*
07	*Teacher: Ali, Ali what do think?*
08	*frost over.*
09	*Teacher: Ahmet?*
10	*frost over*
11	*Teacher: Serhat you tell me.*
12	*This is called frost over because the gas turns to solid.*
13	*Teacher: OK. Selin what did you write?*
14	*Because grass also breathes and dew forms. With the cold of the air, the dew freezes and frost forms.*
15	*Teacher: It must be dew and then it should freeze. Hıı. If dew freezes, condensation occurs first and then freezing. It should freeze immediately without dew, that is, without liquefying.*

EXPRESSING PERSONAL NEGATIVE FEELINGS

This feedback was defined as the teacher's destructive expression of negative feelings about students' behaviour. In this type of feedback, the teacher reflected the negative feelings he felt towards the students by getting angry with the students loudly, reproaching them, or downplaying the answers and behaviours of the students.

In table 4 in the worksheet 2E level about the subject of “State Changes” students are doing an experiment to discover the characteristics of pure substances. The teacher scolded the student in line 10 for the wrong answer of one of the students and asked him to give his opinion after careful observation. This feedback is within the scope of the teacher's feedback of *expressing personal negative feelings* by raising his/her voice to the student and scolded the student.

Table 4. *Expressing Personal Negative Feelings*

Line	*Utterance*
01	*Hundred*
02	*Teacher: Did it get to 100?*
03	*Yes it did.*
04	*Teacher: Has it been 101?*
05	*Yes.*
06	*No.*
07	*No my teacher, it hasn’t been.*
08	*Teacher it is getting over it.*
09	*What then!*
10	*Teacher: How did it happen? Look and then tell me. (Loudly).*
11	*Teacher, it will be a little later.*
12	*Teacher: Look, if you lean on the water, it's not from me. You'll get burned, don't go to the hospital and then say teacher or something. Is it 101?*
13	*Teacher it is 100*
14	*Teacher: Isn’t it going to be 101 ever?*
15	*It will be.*
16	*Teacher: It won’t be. Because it started to boil. After the liquids boil their temperature does not change, OK? Well, when the ice is melting, did its temperature continue to change?*
17	*No.*

FOREGROUNDING THE INDIVIDUAL OR GROUP

The teacher's appreciation of a student's or group's response and work and showing an example to the class is called " Foregrounding the individual or group ". Teacher comparing the answers of

students or groups, asking the student who gave the correct answer during the discussion to repeat the answer, asking the student whose work he likes to show the work to the class are the codes of this feedback type.

Teacher emphasized that the answer of one student is more qualified than the answer of the other students by comparing the thoughts shared by the students during the class discussion in the 1st and 3rd lines of table 5. For this reason, he provided feedback foregrounding the individual or group in lines 1 and 3.

Table 5. *Foregrounding the Individual or Group*

Line	*Utterance*
01	*Teacher: All right. Let's move on to the other view. Hasan directly diagnosed the patient. He said "Uncle Ahmet, is a kidney patient.*
02	*Is that right my teacher?*
03	*Teacher: I don't know. What do you think? You know, you said that smoking and alcohol may have caused, that's why you said that it may have been cancer. You said he is a dialysis patient. Some of your views have remained the same, some have changed. But Hasan made the diagnosis just like a doctor. He said that Uncle Ahmet has kidney disease.*

EXPLAINING THE PROCESS

The teacher's explanation about what is expected from the students in the learning process, the process steps of the study, or the safety precautions is called "process-related feedback ". The codes for this feedback are the teacher's explanations below; explaining the point to be reached, saying that the task needs to be reviewed, reminding the target or problem, stating that it is not related to the subject, explaining the process steps or working method related to the study to be done, asking the students for the names of the research sources, making explanations about the safety precautions, asking them to do it clean and tidy, explaining about the supply of test materials.

Given in Table 6, questions were asked to all students and a classroom discussion was held so that the students could make an analogy between the discharge of the ashes formed by the burning coal in the stove in step 2E of the worksheet on the subject of "Excretion". After the students set up the analogy, teacher asked them to describe the excretion as in the 1st line. When one of the students mentioned the events that help with the excretion in the 11th line, the teacher reminded the target to the student who went out of the topic by using the expressions in the 12th line. The teacher's statement on line 12 is within the scope of the *explaining the process feedback.*

Table 6. *Explaining the Process*

Line	*Utterance*
01	*Teacher: Well, was there a situation similar to cleaning this stove in our body?*
02	*Yes.*
03	*Teacher: Where does this event take place?*
04	*In our muscles.*
05	*In our organs.*
06	*Teacher: All right. What is the name given to the removal of waste material accumulated in our muscles from the body? Say it Deniz.*
07	*excretory system.*
08	*Teacher: "Excretion". Beautiful. Well, let's define discharge. Let's combine the words you have learned so far and make a sentence, let's see what is "Excretion"? Tell me, Defne.*
09	*The removal of waste materials from our body.*
10	*Teacher: He talked about waste matter, he talked about getting away from the body. Any other ideas?*
11	*Sweating.*
12	*Teacher: That's not exactly our topic, is it? We are talking about waste materials inside the cell now. Another*
13	*Urine.*

REFLECTION FEEDBACK

The teacher's submission of student answers or group work to the approval of the class and getting ideas from the students about the answer or study is called "reflection feedback". The codes of this feedback are that the teacher presents the students' answers for the approval of the class, the students direct their ideas to the other students, the students ask the reasons for their agreement or not, and the students get their ideas about the study after the group work is presented to the whole class.

In the activity related to the subject of "Measurement of the Magnitude of Force" in table 7, a problem situation was presented to the students and questions were asked about the problem situation. In the first line, teacher directed the answers of the 3 students who were doing research to the post-research questions to the class and asked the students' ideas about these answers. In the 3rd line, the teacher directed another student's research to the class and asked their opinions. In lines 1 and 3 of this dialog, teacher uses *reflection feedback*.

Table 7. *Reflection Feedback*

Line	*Utterance*
01	*Teacher: Hmm. Well, then guys, let me ask you all a question. Now you all had an estimate of the unit of the magnitude of your force. Hasan's guess was the dynamometer. Then he found a dynamometer again. Defne's guess was degrees, which Newton found after research. Ali's guess was the weight of the crate, and after research, he found the weight of the crate again. What do you say? Three people did research, and all results are different. Ayse, you have said that you did research as well, do you remember what was the unit for the magnitude of force?*
02	*Newton.*
03	*Teacher: Did you find Newton? Hmm. There are four research. Two of them are Newton, one is dynamometer, and one is the weight of the case. What do you say?*

FEEDBACK ABOUT PEER RELATIONS

The behaviour of the teacher towards the disagreements between the students is classified as "peer relations" feedback. The codes of this feedback type are that the teacher ignores the disagreements between the students, bypasses them, offers solutions for the disagreements or warns the students.

In Table 8, the students try to do the activity in the 3E step of the worksheet on the topic "Distinguishing Properties of Matter" by discussing it as a group. In line 1, one of the students states that she is uncomfortable with her groupmate. The teacher asked questions about the disagreement between the students. Teacher shows in line 12 that this situation bothers him. In line 14, he warned the student who was disturbing his friends. On line 14, where he warns about in-group disagreements, teacher presented feedback about peer relations feedback.

Table 8. *Feedback About Peer Relations*

Line	*Utterance*
01	*My teacher Ahmet passes the pencil box and takes it back.*
02	*Teacher: Selin, Is Ahmet only messing with you like this? Is he messing with Ali and Duygu?*
03	*Yes, my teacher he has taken my pencil case.*
04	*Teacher: Is Ahmet messing with others?*
05	*Sometimes he messes with.*
06	*Teacher: Sometimes. Is he messing with you more?*
07	*No.*
08	*Teacher: What does he do, does he take your pens?*
09	*No teacher.*
10	*Teacher: What does he do?*
11	*He hits me.*
12	*Teacher: Off…*
13	*My teacher Ali also goes, lifts and does not give.*
14	*Teacher: Ahmet don't do it don't disturb your friends.*

NOT GIVING FEEDBACK

Failure of the teacher to respond to student questions or answers or giving another student the right to speak is classified as "not giving feedback". The codes of this feedback type are that the teacher remains silent in the face of the student's answer or gives another student the right to speak. In the 2E step of the worksheet on the subject of "Friction Force" in table 9, the students designed an experiment and presented it to the class. The teacher asks the students about the controlled variables of the experiment. In the 5th and 6th lines, when the students mixed up the independent variable and the controlled variables, teacher explained why he did not accept the students' answers in the 7th line. When the wrong answer he explained in the 8th line was repeated by another student, the teacher did not respond to the student. He continued the lesson by asking the experimental group what the control variables in their experiments were. It is within the scope of *not giving feedback* if the teacher remains silent on the 9th line and then directs the question to the students in another group on the 10th line.

Table 9. *Not Giving Feedback*

Line	*Utterance*
01	*Teacher: So, what are your variables that you control?*
02	*Control variable.*
03	*Car.*
04	*Teacher: Let's evaluate the car as a whole, another car, what else did you not change?*
05	*My teacher, board.*
06	*Tile.*
07	*Teacher: No look wood and tiles, we have changed the floor, haven't we?*
08	*My teacher the floor.*
09	*Teacher: …. (No answer).*
10	*Teacher: What else might not have changed? The second group, the first group, the first group, you did such an activity, what could be the variable you controlled in this activity? Other than the type of another car?*

COMPARISON FEEDBACK

The teacher's comparison of answers or work to enable students to discuss different situations is classified as "comparison feedback". The teacher can enable students to compare two experimental setups, ideas or studies. The teacher of this feedback compares the students' predictions with the observations made during the research process, compares the answers of the students or groups, compares two predictions of a student, compares two situations/experimental setups.

In the 4E step of the worksheet on the subject of "Heat Exchange" in table 10, the students were provided to compare the two arguments. In line 1, the teacher presented these arguments and asked the students to decide which one is correct by having a group discussion. Teacher provided *comparison feedback* by allowing students to compare two different arguments.

Table 10. *Comparison Feedback*

Line	*Utterance*
01	*Teacher: In the 3rd activity, you are given two sentences, look, they gave you a sentence, not a question. He says that the temperature of every substance that receives heat increases. The other thing is that the temperature of every substance that receives heat does not increase. Which one do you think is correct?*
02	*Second one*
03	*Number two.*
04	*Teacher: Decide that as a group. Write your reason for why you think so, let's find out.*

FUNCTION OF THE FEEDBACK

It is the feedback given by the teacher in order to affect the inquiry behaviours and achievement goal orientations of the students in the learning environment. The feedback provided by the teacher during the inquiry process can lead students to increase their knowledge, learn to improve themselves,

to prove their ability to others, to be appreciated, to learn to win the competition. At the same time, teacher's feedback can lead students to research, use scientific process skills, think, discuss, or become the recipient of information conveyed by others and learn by rote. Function of feedback; It consists of feedback sub-categories that support mastery goal orientation, performance goal orientation, continue the inquiry process, and ending the inquiry process.

FEEDBACK SUPPORTING THE MASTERY GOAL ORIENTATION

It is the feedback provided by the teacher to ensure that students learn about a subject in order to increase their own knowledge, give importance to effort and enjoy learning. The codes of this feedback type are not to leave the student in a difficult situation, to focus the students on the target, to increase the self-efficacy of the students, to enable them to make self-evaluation, and to approve the student's effort in the process.

In table 11, the worksheets related to the subject of "Excretion" are discussed about the burning of coal in the stove in step over all the examples, so that they can make an analogy with the subject of " Excretion" and emptying the containers of the burning coal. After the students made the analogy, the teacher asked questions as in the 1st line so that the students could establish a relationship between cleaning the ash in the stove and " Excretion". In the 8th line, the students emphasize that they have learned many things before and ask them to define the excretion event by using what they have learned, thereby increasing the self-efficacy of the students. For this reason, the teacher's statements on the 8th line are included in *the feedback to support mastery goal orientation*.

Table 11. *Feedback Supporting the Mastery Goal Orientation*

Line	*Utterance*
01	*Teacher: Well, was there a situation similar to cleaning this stove in our body?*
02	*Yes.*
03	*Teacher: Where is this happening?*
04	*In our muscles.*
05	*In our organs.*
06	*Teacher: All right. What is the name given to the removal of the waste material accumulated in our muscles from the body? Let's give it a name. Tell us Deniz.*
07	*Excretory system.*
08	*Teacher: Excretion. Good. All right, Let's define this excretion. What are you going to say? Let's combine the words you have learned so far and make a sentence. What is excretion? Tell us Defne.*
09	*Removal of waste materials from our body.*
10	*Teacher: He talked about waste matter, he talked about getting away from the body. Any other ideas?*

FEEDBACK SUPPORTING PERFORMANCE GOAL ORIENTATION

Teacher's feedback that causes students to compete with each other, try to show others that they are talented, avoid appearing incompetent, and work for grades is classified as "feedback that supports performance orientation". The codes of this type of feedback are that the teacher evaluates the students with a grade, blames the students, threatens not to let them do the experiment or not to share their research with the class, says negative words about the self-efficacy of the student, shows the students who did the task as an example to the students who could not do the task, and mocks the answers of the students.

In table 12, students fill in the excretion event in the relevant sections of the worksheets by making use of the model they previously created as a group in step 5E of the worksheet on the subject of "Excretion". In the meantime, when the voice rose, teacher explained that this evaluation activity made by the students would be evaluated with a grade and focused the students on the grade. In line 1, teacher provided *feedback supporting the performance orientation.*

Table 12. *Feedback Supporting Performance Goal Orientation*

Line	*Utterance*
01	*Teacher: OK guys, now I will distribute one evaluation sheet to you. You will receive points for these studies you have done, and this will be added to your grades along with the exam grade. How much did you learn? We will have a written exam. But we'll see how much we learned from the measurements on these papers, okay guys? You do your work by paying attention to these. If there is anything you do not understand, you can ask.*

FEEDBACK THAT CONTINUES THE INQUIRY PROCESS

The feedback provided by the teacher in order to direct the students to identify a problem situation, to produce solutions by making predictions, observations, research, experiments, discussions, comments, and to share with the class is classified as the *feedback that continues the questioning process*. The codes of this feedback type allow the teacher to focus the students on the target, emphasize the contextual feature of the information, direct the students to discuss, rethink and research, compare the prediction with the observation, reveal the foreknowledge, deepen the explanation, enable the students to look at the problem from different angles, make inferences and share, and prevent in-group disagreements. Waiting for a solution from the students, offering a solution to the disagreements within the group, and revealing different ideas.

In the 4E step of the worksheet on the topic "Distinguishing Properties of Matter" in table 13, an experiment was conducted for students to observe that the boiling point is not constant for impure substances. Two different setups were designed for this experiment. The students made observations while equal amounts of water were added to the first and second experimental setups and heated with identical heaters. They guessed what could be done to stop the boiling. By focusing the students on the target in the 1st line; with the expressions in the 8th, 11th and 13th lines, he provided *feedback that continued the inquiry process* by allowing the students to compare their predictions and observations and make comments.

Table 13. *Feedback that Continues the Inquiry Process*

Line	*Utterance*
01	*Teacher: So, I'm asking you. I took the water from here without turning off the fire of these boiling waters. Can you stop it boiling without adding water to it?*
02	*Teacher by adding salt.*
03	*By adding salt.*
04	*Yes*
05	*My teacher I think, its temperature drops.*
06	*Teacher: Really?*
07	*Yes.*
08	*Teacher: By adding salt, let`s add some salt.*
09	*Teacher: Yes, is it ok if I add that much salt?*
10	*It is OK my teacher.*
11	*Teacher: Look, it's 100 degrees, but I'm adding salt. What happened to boiling?*
12	*It stopped.*
13	*Teacher: The other one continues, let's see the temperature.*
14	*100.*

FEEDBACK THAT ENDING THE INQUIRY PROCESS

Feedback that causes the students to be in the position of the recipient of the transferred subject without thinking by the teacher by directly transferring the subject to the students, trying to manage the students' learning, interpreting the correct and incorrect answers of the students, is classified as "feedback that ends the inquiry process". The codes of this feedback type are the teacher's approval of his/her answer, the explanation of the target, the direct answer, the explanation of the wrong or correct reason in the student's answers, the approval of the information from the student,

the use of the information from the student as well as adding an explanation, directing the student to the information source.

In Table 14, in the 2E step of the worksheet on the subject of "Heat Exchange", teacher learned that the students did not conduct research. In line 5, he asks the students who do not do research to do the 2E (Exploring) activity as a group and gives the students time. In the speech of the 1st group, it is understood that the students' knowledge is not sufficient to carry out the relevant activity and they are indecisive about the questions since they do not conduct research on the subject. Teacher provided feedback that *ends the inquiry process* by leaving the students who did not do research alone during the questioning process, not producing a solution, and directing the students to complete the relevant activity only. The presentation of this feedback caused the students not to be able to complete the deficiencies in their prior knowledge and to continue questioning.

Table 14. *Feedback that Ending the Inquiry Process*

Line	*Utterance*
01	*Teacher: Guys, you should have researched these "Heat Exchange" concepts because of the first activity. Who did the research?*
02	*(No response).*
03	*Teacher: Didn't anyone do it? What is heat, what is temperature? Is not there anybody who did?*
04	*(No response).*
05	*Teacher: Yes, the term is ending, look, there is 1 more week after this week ends. You still haven't gotten into the habit of doing the activities. All right let's discuss heat and temperature as a group, as far as you know. Complete it into the star with that triangle. As a group. (1st group speech).*
06	*Does the thermometer belong to heat or temperature?*
07	*Heat*

DISCUSSION, CONCLUSION AND IMPLICATIONS

In the literature, feedback is classified according to the course content, approach to learning, grade level, focus, relationship with the target and method. In addition, feedback has been defined within the scope of more than one course (Tunstall et al., 1996; Voerman et al., 2012, Berg et al., 2013). However, it can be thought that the feedback determined independently of the nature of the course and the learning strategy used will not provide enough detail about that course. There are studies in the literature that examine feedback in science lessons and even within the scope of inquiry. However, in these studies, they only focused on the following types of feedback: student mistakes (Cengiz et al., 2017), laboratory reports (Chalmers et al., 2014), discussion loops (Rinehart et al., 2020), student experiments (Eckes et al., 2019), correct and incorrect answers (Chin, 2006). The social and affective dimensions of scientific inquiry have not been adequately studied. Although feedback has been examined in the literature as a variable that affects achievement-goal orientation, this variable has not been included in their classification. In this study, the teacher's verbal feedback was handled within the framework of cognitive, affective and social dimensions of IBL, different from the literature, and classified according to its method and function. Reflection, comparison feedback in the method category; In the function category, feedbacks that continued the inquiry process and ending the inquiry process were determined.

Continuing inquiry in science classes can be challenging for teachers (Quigley, Marshall, Deaton, Cook, & Padilla, 2011). If teachers know the feedback, they need to provide in the IBL environment, it can be easier to guide learning, motivate students to the lesson, and support their academic success. It may not be enough for the teacher to focus only on the experiment, the level of openness of the experiment, the readiness of the students, the structure of the subject in the questioning environment. Reciprocal determinism forms the center of Bandura's social learning theory. In this concept, the environment, individual characteristics and behaviour mutually affect each other (Bandura, 1977). Teacher should also take into account the correlation between these affects.

Because all the variables that make up all the components of the learning environment, such as the individual characteristics of the students, the teacher's approach, and the method he uses, affect each other (Bandura, 1977). The relationship between these variables is provided through feedback. Every feedback (environment-individual) given by the teacher to a student actually creates a criterion in the classroom environment. According to this criterion, the student who is given direct feedback and other students may be affected by this criterion by showing a behavioural change (environment-behaviour).

Feedback presented in the IBL environment is related to the teacher's role in the learning environment. Considering the feedback of the method and function categories (Table 1), the teacher can predict how to apply the inquiry and how the feedback he/she presents may affect the students emotionally. In class where a teacher is unaware of the method or function of the feedbacks, it may not matter why the query is interrupted. Teacher can prevent students from inquiry by making direct corrections when students make mistakes. A teacher who is aware of the feedback method, on the other hand, can continue inquiry by supporting students with different feedback such as reflection (Table 7), comparison (Table 10), and opportunity (Table 2) in the face of mistakes. A teacher who is aware of the function of feedback can predict how the feedback he provides may affect students cognitively and emotionally. Instead of focusing on the notes, it directs the students to effort and learning together and prepares the students to learn emotionally. The fact that feedback is handled independently of questioning in the literature has caused the situations mentioned here to be overlooked. This study has attempted to fill this gap.

Strippel et. al., (2015) determined that in the application of inquiry-based science lessons, the components related to the nature of scientific inquiry were ignored and focused more on skill and concept teaching. For this reason, teachers' feedback in science lessons has been limited to teaching skills and concepts (Chin, 2006; Chalmers et. al., (2014; Cengiz, 2015; Eckes et. al., 2019). Another limitation here is how consciously teachers give feedback. A teacher who does not recognize the feedback can lead his students to undesired goals in the program in terms of cognitive and affective sense. However, the teacher who uses the feedback consciously will contribute more to learning. For example, by consciously presenting the comparison feedback (Table 10) , it can make students feel that different experiments can be done for a subject, that is, scientific research can be done by following different paths (Lederman, Lederman, Bartos, Bartels, Meyer and Schwartz, 2014). In scientific research, students can try the experiments more than once (Osborne et. al., 2003) by providing opportunity feedback (Table 2). It can be emphasized that the data collected with the comparison feedback and the research questions should be consistent (Lederman et. al., 2014). With reflection feedback (Table 7), the results obtained can be shared and ideas can be discussed (Schwartz, Lederman, & Lederman, 2008).

Feedback provides students with information about which tasks the Teacher values. Teacher, who uses the feedback consciously, can direct his students to the goals determined by the program with these messages. For example, it uses process feedback (Table 6) to draw attention to course-related procedures, while using opportunity feedback (Table 2) to elicit students' ideas. But the unconscious use of feedback can cause students to lose their way in the process. It can also emotionally lead to undesirable targets. For example, positive feedback given only to getting high grades can push students towards results and performance goal orientation (Table 12). However, the feedback presented to the development in the process will enable the students to turn to the learning goal orientation (Table 11).

Feedback is also a determinant of the criteria in the classroom. Doing research, working collaboratively, considering the opinions of others, presenting reasons, revealing different ideas, and having a class discussion about an idea are important criteria in the IBL environment (Lederman et. al., 2014). For example, while teachers provide insufficient feedback on the tasks that students have accomplished, they provide more feedback on deficiencies (Voerman et. al., 2012), which may cause students to focus more on not making mistakes. However, in this case, it is overlooked that there are

errors in the nature of scientific inquiry. The teacher's presentation of comparison feedback (Table 10) on an experiment may provide an opportunity for students to realize their mistakes in the experiment and to review the results of the experiment with giving feedback. When the teacher gives the opportunity to the student by asking additional questions without interrupting the inquiry when the student makes a mistake, the students may realize that making mistakes is an acceptable situation in the inquiry environment and even an important opportunity for learning. In this case, the student can take a more active part in the learning environment instead of avoiding making mistakes.

Continuity of inquiry is related to keeping students cognitively active in the learning environment. Students must be motivated to question in order to be cognitively active. Feedback plays a key role in ensuring the continuity of inquiry in science lessons. The types of feedback that interrupt (Table 14) or continue the inquiry (Table 13) determined in this study play a decisive role in the continuation of the inquiry. At the same time, it is expected that the feedback supporting the learning (Table 11) and performance orientation (Table 12) determined in this study will direct student motivation in order to maintain the inquiry.

In the inquiry environment, teacher may cause students to focus on research, discussion, asking questions or learning, gaining knowledge, attention to the importance of effort or showing the best performance that they will undertake during the inquiry process. In this way, students are affected emotionally by the feedback. In addition to the way the teacher's feedback is presented in the IBL environment, how it affects students cognitively and affectively is also important (Geitz et. al., 2013). When students are given the opportunity (Table 2), they are affected positively emotionally, and inquiry can continue. However, if the teacher reflects their negative feelings (Table 4), highlights a student (Table 5) or does not provide feedback (Table 9), students may be negatively affected, and inquiry may be interrupted .

Considering that the feedbacks cannot be independent of the strategy used and the lesson, in this study, the science lessons in which the inquiry was applied were observed, reflecting (Table 7) and comparing (Table 10) the feedback types available in the literature in the method category; In the function category, feedback types that continue the inquiry process (Table 13) and interrupt the inquiry process (Table 14) have been added.

The limitation of this study is the determination of feedback in a classroom where inquiry is at a high level. Researchers can identify the types of feedback in different levels of IBL settings. The effect of inquiry-oriented feedback on cognitive and affective characteristics in the learning environment can be examined with experimental studies. Considering that the feedback is specific to the field and the strategy used, applied training on inquiry-based feedback and its types can be given in the pedagogical field trainings given to teachers in the field of science. At the same time, the types of feedback should be taken into account in the preparation of course resources. For example, these types of feedback can be used consciously in the dialogues in the text.

AUTHOR CONTRIBUTIONS

The first author contributed to data collection, literature review, and preparing the discussion and conclusion sections. The second author contributed to determining the theoretical framework of the study, analyzing the data, and preparation of the methodology. Both authors critically reviewed the article and approved the final version.

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Aggression and Life Goals in Adolescents: Mediating Effect of Visions About the Future and Moderating Effect of Gender

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Abstract

Aggression can be considered as a problem for a long time in Türkiye, especially among adolescents in schools. Although few previous studies have confirmed the negative effects of life goals on aggression, the mechanism of how life goals affect aggression and whether this varies with gender difference is still unknown. To address this research gap, we tested the mediating effect of visions of the future and the moderator effect of gender. The study group consisted of 516 high school students in Turkish. The students completed Adolescents' Life Goals Scale with Respect to Positive Psychotherapy, the Visions about Future Scale, and the KAR-YA Aggression Scale. Structural equation modeling (SEM) revealed the indirect impact of life goals on aggression through visions about future. In addition, the conditional process analysis results showed that this indirect effect was moderated by gender.

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INTRODUCTION

Aggression is a public health problem with economic social, and emotional consequences during adolescence (Vega et al., 2021). Studies have shown that aggression causes physical, emotional, and relationship problems in adolescents and that adolescents commit more crimes following their aggression (Benish-Weisman, 2019; Krettenauer & Eichler, 2006). We think that the determination of the variables associated with aggression is important in developing interventions to reduce and prevent this problem. Although it varies from person to person, there are many sources of aggression during adolescence (Benish-Weisman, 2019). There are views suggesting that aggression in adolescence occurs as a result of the interaction of individual characteristics, such as suicidality (Detullio et al., 2021), low self-esteem, peer rejection, peer pressure, academic failure (Miller, 1994), and environmental characteristics, such as poverty, limited social support, and lack of family control (Coie et al., 1993; Shin, 2017), domestic violence (Perry et al., 2021). It is also stated that adolescents often experience inadequacy in life skills, such as communication, conflict resolution, anger management and, problem-solving (Breunlin et al., 2002; Weir, 2005). It is stated that not having behavioral alternatives for overcoming the deficiencies and difficulties in such life skills also leads to aggression in adolescents (Yavuzer, 2013).

When the studies conducted to date are examined, no research has been found that examines the future visions and the direct and indirect effects of gender on the relationship between life goals and aggression. Therefore, in this study we aimed to address this knowledge gap, provide an integrated perspective and adopting a positive psychology approach on the relationship between life goals and aggression. Specifically, in this study we examined the association between life goals and aggression among Turkish adolescents. The change and transformation of the social structure in Türkiye has led to the increase of various social problems. This is social one of the problems is the increase in aggressive behavior. The increase in aggressive acts in school environments is a detailed explanation of the issue requires that it be addressed (Üçüncü & Özada-Nazım, 2022). This situation is one of the important motivation factors in the conduct of the research. We also investigated the mediating effect of visions about the future and moderating effect of gender, which may help us better understand the relationship between aggression and life goals.

THE RELATIONSHIPS BETWEEN AGGRESSION AND LIFE GOALS

Adolescence is an important and critical period since it is a period in which individuals' ability to make rational and healthy plans for the future develops (Reininger et al., 2003). With the development of this competence, adolescents begin to establish life goals (Sheldon & Lyubomirsky, 2006). Life goals are defined as situations that individuals wish to achieve with the help of their cognitive and behavioral strategies (Emmons, 1999). Life goals associated with situations and lifestyles that are attributed short or long-term meaning have an important place in the self-definition of the individual (Wrosch et al., 2003). At the same time, life goals are resources that help individuals to connect to life (Korkmaz & Cenkseven-Önder, 2019). Life goals are expressed under three different structures: relationship goals, career (achievement) goals, and entertainment goals (body-sense) (Eryılmaz, 2010). Career goals include determining the kind of education a person will receive in his life, jobs he/she will work in, and how he/she will progress and develop in his/her job. Relationship goals guide the person to determining the characteristics of the person to marry, having an idea about the number of children they want to have in the future, and planning the activities to be performed with the child. Entertainment goals, on the other hand, involve sportive activities to be performed throughout life, leisure activities such as going to the cinema and theater, and hobbies to evaluate free time (Eryılmaz, 2010).

Determining life goals in adolescents is considered one of the prerequisites for healthy development (McGregor & Little, 1998). The presence of life goals provides adolescents with the advantages, such as self-management, determining new strategies to achieve goals, using time,

energy, and resources correctly, and keeping motivation alive (Massey et al., 2008; Snyder, 2002). According to Zhang and Zhang (2017), individuals with life goals have a low tendency towards engaging in harmful and aggressive behaviors because the existence of life goals leads individuals to seek healthy solutions for problems (Peseschkian, 1996). On the contrary, not choosing healthy solutions for problems can lead individuals to destructive ways, such as anger, rage, and violence (e.g. Arslan & Demirci, 2019; Johnson, 2009; Yavuzer et al., 2013). In the context of what was stated, we considered that the increase in life goals might be related to the decrease in aggression.

MEDIATING EFFECT OF VISIONS ABOUT THE FUTURE

Visions about the future that include hope, optimism, and low levels of pessimism are effective in adolescents' educational, professional, and career development (Ginevra et al., 2017; Savickas, 2013). In addition, visions about the future are considered as an important factor for adolescents in terms of affecting their health, well-being, and positive behaviors (Sun & Shek, 2012). Optimism, which is one of the important components of visions about the future, is defined as individuals' strong expectations that the future will be good despite having difficulties in life (Goleman, 2000). It is stated that individuals with high levels of optimism show resilience in the face of many challenging life tasks (Brissette et al., 2002). Optimistic individuals tend to make more effort, be insistent, and endure difficulties and face them to reach their future aspirations (Ginevra et al., 2017). On the other hand, pessimism is defined as individuals' expectation that they will experience something bad (Carver et al., 2010). Hope is expressed as an individual's motivation to achieve the goals set for the future (Snyder, 2002). In other words, hope is an emotion that enables people to be successful in difficult situations or situations that are important to them (Santilli et al., 2017).

Visions about the future may also be associated with adolescent aggression. Because optimism, which is one of the important components of visions about the future, is defined as a strong cognitive filter that affects adaptive behaviors and thoughts shown in the face of events (Forgeard & Seligman, 2012). The adaptive effect and cognitive filter of optimism can help the individual to control the factors that lead to aggression. As a matter of fact, studies have found that optimism has significant negative effects on aggression (Coneo et al., 2017). Pessimism is positively associated with aggression (Hasan, 2002). Studies revealing that pessimistic adolescents experience higher levels of stress (Orejudo et al., 2012) and anger (Puskar et al., 1999), which are important predictors of aggression, support this claim. Hope, which is another important component of visions about the future, is a source for positive emotions, functional and constructive thoughts, and behaviors that are negatively related to aggression (Ahmadi et al., 2017; Halevy, 2017). Based on what was stated, we thought that the increase in visions about the future was associated with the decrease in aggression.

Individuals' determination of life goals and finding ways to achieve these goals are considered to be important factors for hope, which is the main component of the visions about the future because the goal is stated to be the cognitive part of hope (Korkmaz & Cenkseven-Önder, 2019; Snyder, 2002). On the other hand, lack of goals causes individuals to experience despair (Snyder, 2002). Setting goals is also associated optimism and low levels of pessimism. Evidence suggested that having an optimistic view of the future and not being pessimistic may be directly related to having and pursuing that goal (Carver et al., 2010). In addition, setting goals and spending efforts to reach these goals are expressed as a motivation factor. This motivation, which individuals use to achieve their determined goals, increases their optimism towards the future and decreases their pessimism (Carver et al., 2003). In the context of the theoretical framework and studies reported, we thought that the increase in life goals would be related to the increase in visions about the future. As a result, we thought that visions about the future could play a mediating role in the relationship between life goals and aggression.

MODERATING EFFECT OF GENDER

It has been reported in previous studies that the aggression levels of men and women are different (e.g. Cillessen & Borch, 2006; Cui & Lan, 2020; Yavuzer & Karataş¸ 2013). Studies have shown

that male adolescents have higher aggression levels than female adolescents. On the other hand, gender may be the reason for differences in adolescents in terms of acquiring life goals. Türkiye generally has an eastern culture and a patriarchal structure (Tagay et al., 2016). Depending on this situation, the values transferred to individuals differ in terms of gender. Studies on values have shown that in such societies, males attach more importance to values, such as achievement, hedonism, and power and that females attach importance to values, such as universality and benevolence (Demirutku & Sümer, 2010; Schwartz & Rubel, 2005). Values, on the other hand, are the principles that guide individuals to set goals (Theodorson & Theodorson, 2000). Accordingly, male adolescents in Türkiye may display a more aggressive attitude than female adolescents based on the life goals and visions about the future they have developed to be strong. In this context, we think that gender moderates the relationships between not only life goals and aggression but also life goals and about the future visions in adolescents.

THE PRESENT STUDY

Adolescents' aggression has become an increasing phenomenon in Türkiye, especially in recent years (Özdoğan et al., 2021; Üçüncü & Özada-Nazım, 2022; Yönet et al., 2016). Examining the variables that can be associated with aggression will undoubtedly support the processes of description and prevention processes of the problem. In this study, a model was constructed that hypothesized that life goals would indirectly predict aggression through visions of the future, while gender would moderate this indirect effect. Specifically, gender will moderate the relationships between not only life goals and visions about the future but also life goals and aggression.

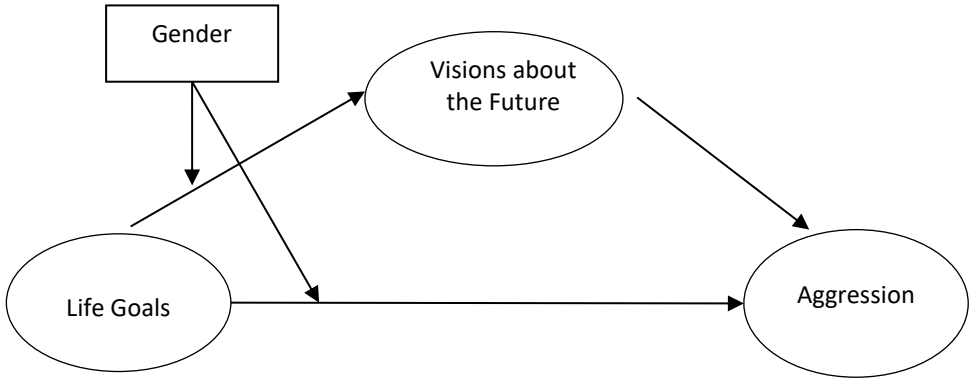
The hypotheses of the present study are as follows (see Figure 1):

H1: Life goals will significantly and negatively predict aggression.

H2: Life goals predicts aggression through the indirect effect of visions about the future in adolescents.

H3: Gender moderates the relationships between not only life goals and visions about the future but also life goals and aggression in adolescents.

Figure 1. *The hypothesized structural mode*



METHOD

This study involved a correlational research that examines the relationships between variables (Fraenkel et al., 2012). The predicted variable is aggression and the predictor variable is life goals in the research. In the relationship between the predictor variable and the predicted variable, vision about the future is the mediator variable, and gender is the moderator variable. The moderator effect of gender between life goals and vision about the future was also examined

PARTICIPANTS

We formed the study group of the research using convenience sampling method so that researchers do not experience health problems due to the barriers created by the COVID-19 pandemic. Participants consisted of 516 students, including 273 (52,9%) females and 243 (47,1%) males from four different Anatolian High Schools in a city in the Eastern Mediterranean Region. The age range of the students varied between 13 and 19, and the mean age was 15,43 (*Sd* = 1,30).

DATA COLLECTION TOOLS

AGGRESSION

Karataş and Yavuzer (2016) developed the KAR-YA Aggression Scale to measure aggression in high school and university students.The 23-item scale consists of four sub-dimensions: verbal aggression, physical aggression, anger, and hostility [(e.g. "I can kick people that I am angry with" (physical aggression), "The only way to live in this world is to be merciless" (hostility), "I can easily get furious" (anger), and "I try to impose my ideas on others" (verbal aggression)]. The items are evaluated using a five-point Likert-type scale with options ranging between "never" (1) and "always" (5). Higher scores on the scale indicate increased aggression. The four sub-dimensions of the scale explain 51.71% of the total variance (Karataş & Yavuzer, 2016). In the present study, the internal consistency coefficient (Cronbach's alpha) of the scale was 0,93.

LIFE GOALS

The adolescents' life goals scale with respect to positive psychotherapy was developed by Eryılmaz (2010) to measure whether adolescents set life goals. High scores indicate that individuals have goals in terms of career, relationship, and entertainment. The scale consists of nine items [(e.g. "I have planned the jobs I will work in throughout my life" (career goals), "I have planned the activities I will do with my child throughout my life" (relationship goals), "I have determined the sports activities that I want to do throughout my life" (entertainment goals)]. It has a four-point Likert-type structure with options ranging between "strongly disagree" (1) and "strongly agree" (4). The explained variance of the three-dimensional scale including relationship goals, career goals, and entertainment goals is 65.32%. In the present study, the internal consistency coefficient (Cronbach's alpha) of the scale was 0,77.

THE VISIONS ABOUT FUTURE

Ginevra et al. (2017) developed The Visions about Future Scale to identify individuals' visions of the future (hope, optimism, and pessimism). Akça et al. (2018) conducted the Turkish adaptation study of the scale. The scale consists of 18 items [e.g. "I think I am an optimist" (optimism), "I will not really get what I want" (pessimism), "I feel that I will be quite in a good position in the future" (hope)]. It has a five-point Likert-type scale with options ranging between "not describing me at all" (1) and "describing me very well" (5). All items belonging to the pessimism sub-dimension are scored in reverse. High overall scores on the scale indicate that the adolescent has a positive view of the future, while high scores on a sub-dimension indicate an increase in the related feature in the individual (Akça et al., 2018). In the present study, the internal consistency coefficient (Cronbach's alpha) of the scale was 0,84.

PROCEDURE AND ETHICS

The data of this study were collected from volunteer high school students. The researcher went to four Anatolian High Schools in the vicinity due to the restrictions and risks posed by the COVID-19 pandemic and informed the administrators of the institutions about the research. Upon the approval of the administrators of the institutions, the link to the electronic form of the data collection tools (designed on Google Forms) was shared by the administrators in the WhatsApp groups of the classes. In addition, we have informed consent from participants over the age of 18 and from their parents for

participants under the age of 18. While receiving the answers, no personal information was requested from any participant. This study was approved and registered by the Ethics Committee of Çukurova University (E-74009925-064.01.02-61373).

DATA ANALYSIS

Before our analysis, we tested the conformity of the data to the normal distribution by examining the kurtosis and skewness values. The kurtosis values were between 0,52 and 0,94, and the skewness values were between -0,87 and 0,96. First, correlations among variables and descriptive statistics, were computed in SPSS 25 for Windows. Second, as a primary analysis, confirmatory factor analysis (CFA) conducted in AMOS 24 was employed to test whether the single-factor structure of the measurement tools was supported by the collected data. Third, a structural equation model (SEM) conducted in AMOS 24 was employed to examine the mediation effect of visions about the future. The assessment standards for the goodness of fit index of the model were taken as $\chi 2 / df$<5, TLI> 0,85, CFI> 0,90, AGFI> 0,85, GFI> 0,85, and RMSEA<0,10 (Marcoulides & Schumacher, 2001; Tabachnick & Fidell, 2007). In the bootstrap analysis, a 10,000 resampling and a 95% confidence interval were used to determine mediation effects. Finally, we used SPSS PROCESS macro to test the conditional process model proposed by Hayes (2018). In the bootstrap analysis, a 5000 resampling and a 95% confidence interval were used to determine moderated indirect effect (Preacher & Hayes, 2008).

RESULTS

PRELIMINARY ANALYSES

As the primary analysis, CFA was used to test whether the single-factor structure of the measurement tools used was supported by the collected data. It was found that the single-factor model of the life goals scale [$\chi 2$ (24, N = 516) = 50,223; p< 0,001; $\chi 2/sd$ = 2,09; RMSEA = 0,046; AGFI = 0,96; CFI = 0,98; GFI = 0,98; TLI = 0,97; SRMR = 0,03], the single-factor model of the visions about the future scale [$\chi 2$ (130, N = 516) = 462,534; p< 0,001; $\chi 2/sd$ = 3,55; RMSEA = 0,070; AGFI = 0,88; CFI = 0,93; GFI = 0,91; TLI = 0,92; SRMR = 0,07], and the single-factor model of the aggression scale [$\chi 2$ (216, N = 516) = 769,347; p< 0,001; χ2/sd = 3,56; RMSEA = 0,071; CFI = 0,91; GFI = 0,88; AGFI = 0,85; TLI = 0,89; SRMR = 0,06] were acceptable models that fit the collected data.

THE MEDIATING EFFECT OF VISIONS ABOUT THE FUTURE ON THE RELATIONSHIP BETWEEN LIFE GOALS AND AGGRESSION

The results showed that aggression was found to be significantly and negatively correlated with life goals (r = -0,37, p< 0,01) and visions about the future (r = -0,53, p < 0,01). On the other hand, a significant positive relationship was observed between visions about the future and life goals (r = 0,55, p< 0,01). Gender was found to be significantly and negatively correlated with visions about the future and aggression (Table 1).

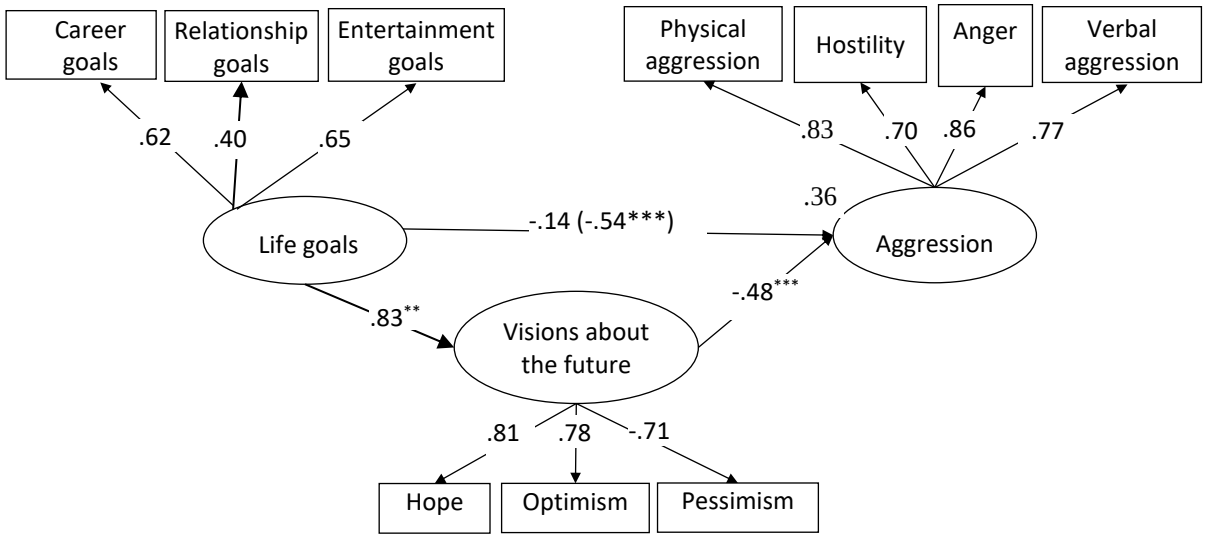
Table 1. *The Descriptive Statistics and Correlations*

	M	*SD*	1	2	3	4
1. Gender	0,47	0,49	1			
2. Life goals	22,69	4,58	-0,03	1		
3. Visions about the future	67,22	14,34	-0,09*	0,55**	1	
4. Aggression	50,01	16,89	-0,12**	-0,37**	-0,53**	1

*p < 0,05, **p < 0,01

First, the path coefficient between life goals and aggression was tested with a model in which visions about the future did not have a mediating role. The goodness of fit values of this model were examined, and it was found that they were acceptable [$\chi 2$ (13, N = 516) = 48,156; p < 0,001; $\chi 2/sd$ = 3,70; RMSEA = 0,072 (LO = 0,05, HI = 0,09); CFI = 0,97; GFI = 0,97; AGFI = 0,94; TLI = 0,95].

Figure 2. *The Hypothesized Structural Model*



Note. The coefficient expressed in parentheses is the coefficient between life goals and aggression before visions about the future was included in the model.

$^{***}p < 0{,}001$

The path coefficient between life goals and aggression was found to be statistically significant (β = -0,54, p< 0,001). Then, the goodness of fit values of the model, in which visions about the future played a mediating role in the relationship between life goals and aggression, were examined, and these values were found to be significant [$\chi 2$ (32, N = 516) = 128,981; p < 0,001; $\chi 2/sd$ = 4,03; RMSEA = 0,077 (LO = 0,06, HI = 0,09); CFI = 0,95; GFI = 0,96; AGFI = 0,92; TLI = 0,94]. The path coefficients of life goals and visions about the future (β = 0,83, p < 0,001) and the path coefficients of visions about the future and aggression (β = -0,48, p < 0,001) were found to be statistically significant. However, with the inclusion of visions about the future in the model, the path coefficient between life goals and aggression was found to be not statistically significant (β = -0,14, p = 0,31). Life goals and visions about the future explained 36% of the variance in aggression (Figure 2).

Table 2. *The Mediating Effect of Visions About the Future on the Relationship between Life Goals and Aggression*

Pathways	β	SE	*95% CI*
Direct effect			
Life goals → Visions about the future	0,83**	0,05	0,74, 0,92
Life goals → Aggression	-0,14	0,18	-0,47, 0,23
Visions about the future → Aggression	-0,48*	0,17	-0,83, -0,15
Indirect effect			
Life goals → Visions about the future→ Aggression	-0,40*	0,15	-0,73, -0,12
Total effect			
Life goals → Aggression	-0,54*	0,06	-0,65, -0,40

Note. CI: Confidence interval. Standardized beta coefficients (β) were reported.

$^{*}p$< 0,001, $^{**}p$< 0,01

The bootstrap method was employed to test the indirect effect of visions about the future. As shown in Table 2, the lower and upper values of the confidence interval in all path coefficients (except for life goals and aggression) do not include zero. That is, the indirect effect of life goals on aggression through the mediation of visions about the future was found to be significant [β = -0,40, CI (-0,73, -0,12)]. However, it was observed that the path coefficient between life goals and aggression was not significant. Therefore, visions about the future had a full mediation role in the relationship between life goals and aggression.

MODERATING EFFECT OF GENDER

The results showed that life goals significantly predicted visions about the future (*β* = 0,91, *p* = 0,03). The interaction of life goals and gender yielded a significant result in predicting visions about the future (*β* = 0,53, *p* = 0,03). This result showed that the effects were significant for both female and male.

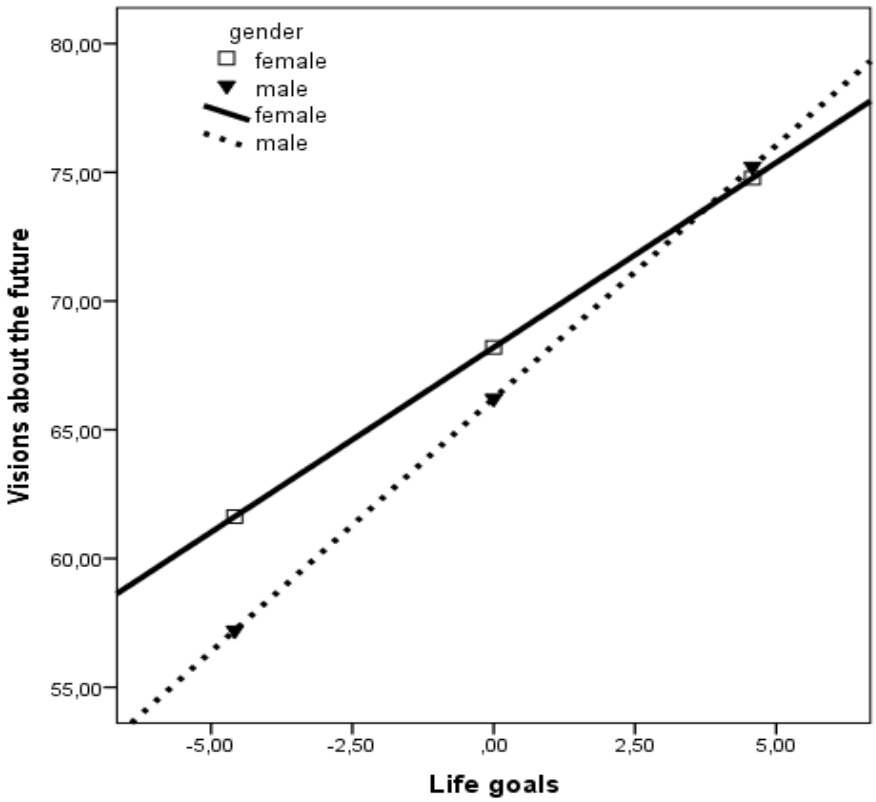
Table 3. *Moderating Effect of Gender on the Relationship between Visions about the Future and Life Goals*

Predictors	Model 1 (Visions about the future)			Model 2 (Aggression)		
	β	*t*	*95%CI*	*β*	*t*	*95%CI*
Gender	-1,98	-1,88	-4,05, 0,08	2,49	1,91	-0,07, 5,06
Life goals	0,91	2,07**	0,05, 1,76	-0,48	0,92	-1,49, 0,54
Life goals X gender	0,53	2,08**	0,03, 1,03	0,03	0,09	-0,64, 0,69
Visions about the future				-0,54	-7,99*	-0,68, -0,41
R^2		0,31			0,30	
F		73,92*			31,05*	

95%CI = bootstrapped confidence intervals.
*p< 0,01, **p< 0,05

Therefore, the effect of life goals on visions about the future was moderated by gender (see Table 3, Model 1, Figure 3). As the Figure 3 shows, compared to females, males reported higher levels of visions about the future given high life goals level. On the other hand, compared to males, female reported higher levels of visions about the future given low life goals level. In addition, when the life goals level of female and male increase, their visions about the future increase, as well. However, the interaction of life goals and gender did not predict aggression (*β* = 0,03, p = 0,93). That is, gender did not moderate the relationship between life goals and aggression (see Table 3, Model 2).

Figure 3. *Moderating Effect of Gender on the Relationship between Visions about the Future and Life Goals*



DISCUSSION

In this study, the relationships between aggression, life goals, and visions about the future (hope, optimism, low pessimism) in adolescents were examined. According to the results of the study, it was found that life goals and visions about the future had a significant effect on aggression. In addition, it was concluded that visions about the future had a full mediation role in the relationship between life goals and aggression. On the other hand, another result of the study was that gender have a moderating role in the relationship between life goals and visions about the future.

First hypothesis of our study was that life goals would negatively and significantly predict aggression. Our study results showed that life goals negatively and significantly predicted aggression. Life goals, which include plans for future, begin to emerge in adolescence (Sheldon & Lyubomirsky, 2006). This becomes a source for adolescents, who begin to form life goals, to act in a more planned way. Existence of life goals motivates adolescents to solve problems and cope with difficulties (Ülküer, 1988). On the other hand, individuals who do not have goals can live more moment-oriented, make inappropriate decisions and, as a result, take destructive and damaging actions due to the lack of future plans (Peseschkian, 1996). Therefore, when adolescents with life goals encounter difficulties and distress, instead of a non-constructive aggressive attitude, they can activate their coping and problem solving-skills.

Second hypothesis of our study was that life goals predicts aggression through the indirect effect of visions about the future in adolescents. It was concluded that visions about the future played a full mediation role in the relationship between life goals and aggression, which confirmed our hypothesis. The results demonstrated that life goals increased visions about the future (especially hope and optimism) and that increased visions about the future reduced aggression. The existence of life goals enables individuals to focus on the future (Emmons, 2003). Future-oriented individuals develop goals and plans that contribute positively to their visions about the future to structure their future (Savickas, 2013). On the other hand, individuals' optimistic, hopeful, and non-pessimistic orientation towards the future are the mechanisms that assist them in exhibiting constructive attitudes instead of aggressive attitudes (Ahmadi et al., 2017; Carver, 2014; Coneo et al., 2017; Hasan, 2002).

Third hypothesis of our study was that gender moderates the relationships between not only life goals and visions about the future but also life goals and aggression in adolescents. In present study we found that the interaction between life goals and gender had a signifiant effect on visions about the future (optimism, pessimism, and hope). In other words, there is a moderating effect of gender on the indirect effect of life goals on aggression. As a result, compared to females, males reported higher levels of visions about the future given high life goals level. Moreover, compared to males, female reported higher levels of visions about the future given low life goals level. In addition, when the life goals level of female and male increase, their visions about the future increase, as well. This finding is consistent with the results of previous studies (e.g. Ginevra et al., 2017). Ginevra et al. (2017) examined gender differences, and observed with male reporting higher levels of optimism and pessimism than female. However, there was no gender difference for the concept of hope.

However, this study did not confirm that gender moderates the direct relationship between life goals and aggression. One of the justifications for creating this hypothesis was that aggression in adolescents differed in terms of gender in studies conducted both in Turkiye and abroad. It has been reported in previous studies that the aggression levels of men and women are different (e.g. Cillessen & Borch, 2006; Cui & Lan, 2020; Karataş et al., 2019; Yavuzer & Karataş¸ 2013). In these studies, the difference was found in favor of men. Another justification was related to the fact that life goals might differ in terms of gender due to the value transfers specific to Turkish culture. Because values are the basic principles in setting life goals (Theodorson & Theodorson, 2000). However, our results demonstrated that the relationship between life goals and aggression was not different for male and female adolescents. This may be also related to the fact that parents do not make any gender

discrimination when transferring values, which have important effects on the acquisition of life goals, to their children (Sheldon & Kasser, 1998).

LIMITATIONS AND RECOMMENDATIONS

The results obtained in this study should be evaluated carefully within the framework of limitations. First of all, a cross-sectional and correlational design was used in this study. Longitudinal studies and experimental design studies are needed to reveal the relationships between the related variables more clearly. While the regulatory effect of gender was being tested, it was assumed that the general value perceptions of Turkish society were effective in setting life goals. In the study, the values of the participants were not measured, which was another limitation. In addition, the results of the study are based on the subjective opinions of the participants. While making generalizations about the results, individuals of similar developmental stages should be considered. Socioeconomic level (SEL) may be an important variable for the variables in this study. Not examining the SEL variable is another limitation of this study.

Based on these findings, applications to set life goals and increase visions about the future can be implemented in individual and group studies to reduce aggression in adolescents. Especially, psychological counselors working in schools should conduct programs that will help adolescents to determine life goals and achieve future orientation so that their tendency for aggression can be reduced or violence in schools can be prevented. Outside of school, the aggressive tendencies of individuals can be reduced by providing information to parents that can help their children establish life goals. Media tools can provide content that encourages future visions and life goals, rather than aggressive content. Thus, the aggression of individuals can be avoided. In this situation, legislators and persons with relevant responsibilities should be supervisory and regulatory.

AUTHOR CONTRIBUTIONS

First author conceptualized the project and contributed to the analysis and interpretation of the findings. Second author collected the data, analyzed the data and wrote the manuscript. All authors reviewed and approved the final version of the manuscript.

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Research Article

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The Effect of STEM-Based Activity Designed for Gifted Students on Students' Scientific Creativity and Cognitive Achievement*

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Abstract

This research aimed to determine the effect of STEM-based activity designed for gifted students on students' scientific creativity and cognitive achievement. Depending on this purpose a simple experimental method, which is one of the quantitative research approaches, was preferred. While the "Scientific Creativity Scale" was used to determine the effect of STEM-based activity designed for gifted students on students' scientific creativity, the "Academic Achievement Test" developed in the field of preferred subject matter was used as part of the research to determine the effect on cognitive achievement. SPSS 25.0 package program was used to analyze quantitative data collected in the form of pre-testing and post-testing. When evaluating the effect of STEM-based activity for gifted students on scientific creativity; the post-test scores obtained by the research group from the scientific creativity scale differed significantly from the pre-test scores. It has been concluded that the nature of STEM-based activity and the steps involved in the engineering design process have an impact on the relevant skill in making a meaningful difference in scientific creativity. When the effect of STEM-based activity developed for gifted students on cognitive achievement is evaluated; it was concluded that the post-test scores obtained from the cognitive achievement test of the research group differed significantly from the pre-test scores. In making a meaningful difference in cognitive achievement, STEM-based activity directs the student to research and question and provides meaningful-lasting learning.

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* This study is made from the doctoral thesis conducted by the second author in the first author's advisory.

INTRODUCTION

Societies that are self-sufficient in the economic, technological, and scientific field, or who want to actively carry out the cycle between science (Levent, 2013), product, and materiality in all aspects, strive to educate individuals who can produce solutions to the scientific problems they face, using criteria such as creativity, critical thinking, and problem-solving in the production process, do not ignore the originality factor and try to come up with new designs using scientific knowledge (Cutts & Moseley, 2004). When the profiles of the individuals that societies strive to raise are considered, the importance of gifted individuals with more advanced cognitive abilities than their peers, which includes criteria such as creativity, critical thinking, problem-solving, and originality, becomes apparent to society (Ayverdi, 2018). Therefore, it becomes a necessity to give these individuals opportunities to develop their skills, maximize their cognitive capacity use and meet their educational needs. When the educational studies carried out to support the development of gifted students and meet their educational needs are examined; Training strategies such as grouping, acceleration, enrichment, and mentoring and training models such as the maker model, Purdue model, Renzulli model, Grid model, Gifted Training Program model, Unlimited Capabilities model, and Autonomous Learning model are found. Although it supports the development of gifted individuals, it needs to be updated and adapted depending on the requirements of the age in the 21st century, called the technology age, given the periods and contents of the emergence of the relevant strategies and models. Given the motto of development and change brought about by the 21st century; It would not be wrong to say that approaches created by bringing together various disciplines, responding to technological developments, and providing comprehensive integration are needed within the educational process to be offered to gifted individuals. This situation has made it inevitable for the STEM approach, which brings together the disciplines of science-technology-engineering and mathematics, to have the potential to respond to technological developments and have an important role in gaining skills that are described as 21st-century skills, to enter the education lives of individuals with special abilities.

The STEM approach, which is an approach that brings together science, mathematics, technology, and engineering disciplines (Bybee, 2010), is very important in ensuring the integration of technology and engineering into the educational process in this age, which is described as the information and communication age, in gaining an interdisciplinary perspective of individuals and in making information meaningful (Holdren, Lander, & Varmus, 2010). The perspective gained and the knowledge that becomes meaningful enable individuals to acquire skills in areas such as creative thinking, critical thinking, and problem-solving strategies and create opportunities for them to enrich themselves culturally and intellectually. This opportunity will be reflected in the scientific and academic research carried out, and it is seen that studies on STEM education are carried out in various subject areas and from different perspectives. When the studies carried out on STEM education or STEM approach are examined; cognitive achievement in STEM (Acar, 2018; Becker & Park, 2011; Bircan, 2019; Ceylan, 2014; Dogan, 2019; Eroglu, 2018; Han, 2013; Higde, 2018; Irkicatal, 2016; Koroglu, 2019; McKinnon, 2018; Sarican, 2017; Tabaru, 2017; Tastan-Akdag, 2017; Wai, Lubinski, Benbow, & Steiger, 2010; Yildirim, 2016; Yildirim & Altun, 2015), meaningful learning in STEM (Kocyigit, 2019; Tseng, Chang, Lou, & Chen, 2011), scientific process skills in STEM (Alan, 2017; Alan, 2020; Ayverdi, 2018; Cotabish, Dailey, Robinson, & Hughes, 2013; Dogan, 2019; Sacan, 2018; Tabaru, 2017; Tastan-Akdag, 2017; Yamak, Bulut & Dundar, 2014; Yildirim, 2016), critical thinking skill in STEM (Acar, 2018; Duran & Sendag, 2012; Hacioglu, 2017), student engagement in STEM (Hedrick, Dizen, Collins, Evans, & Grayson, 2010), STEM profession (Higde, 2018; Karakaya, 2017; Kiriktas, 2019; Kizilay, 2018; Koroglu, 2019; Tseng et all., 2011), motivation in STEM (Higde, 2018; Kizilay, 2018), engineering skill in STEM (Ayverdi, 2018), learning perception in STEM (Gulhan, 2016; Koc, 2019; Reisslein, Moreno, & Ozogul, 2010), problem-solving in STEM (Acar, 2018; Alan, 2017; Bicer, Nite, Capraro, Barrosso, Capraro, & Lee, 2017; Ceylan, 2014; Koc, 2019; Sarican, 2017; Tabaru, 2017), attitude in STEM (Bircan, 2019; Dogan, 2019; Gulhan, 2016; Irkicatal, 2016; Ismail, Zain, & Zin, 2019; Kiriktas, 2019; Kocyigit,

2019; Koroglu, 2019; Lou, Shih, Die, & Tseng, 2011; Sacan, 2018; Toma & Greca, 2018; Yamak et all., 2014; Yildirim, 2016; Zhou, Zeng, Xu, Chen, & Xiao, 2019) and creativity in STEM (Ayverdi, 2018; Bicer et all, 2017; Ceylan, 2014; Eroglu, 2018; Gulhan, 2016; Hacioglu, 2017). Additionally, it is seen that the necessity of ensuring the integration of STEM activities into the education and training process (Gul, 2019; Lin, Hsiao, Williams, & Chen, 2020; Okulu, 2019; Shahali, Halim, Rasul, Osman, & Arsad, 2019; Tunc, 2019; Ustu, 2019; Yazar, 2019), the perception of STEM education (Jeong & Kim, 2015; Kiriktas, 2019; Knezek, Christensen, Wood, & Periathiruvadi, 2013; Lee et all, 2012; Marulcu & Sungur, 2012), the views on STEM activities (Karahan, Canbazoglu-Bilici & Unal, 2015), the effect of STEM education on interest (Hsu, Lin, & Yang, 2017) and the intentions of the STEM (Lin & Williams, 2016) are determined. When the literature is examined considering the gifted individuals and the STEM approach; It is seen that the effect of the STEM approach on the knowledge status of gifted individuals towards natural sciences (Robinson, Dailey, Hughes, & Cotabish, 2014), scientific process skills (Ayverdi, 2018), 21st-century skills (Kulegel, 2020), creativity (Ozcelik, 2017), mental models for STEM (Mullet, Kettler, & Sabatini, 2018) and attitude towards the concept of engineering (Koyunlu-Unlu & Dokme, 2017) has been determined.

Few and far between were studies in which the skills and competence areas of gifted individuals were considered together, and the effect of STEM was evaluated. However, considering the skill such as critical thinking, creativity, and problem-solving that STEM activities carried out based on the engineering design process try to provide to individuals, it would not be wrong to state the characteristics that distinguish gifted individuals from other individuals. The characteristics that STEM education tries to be learning outcomes coincide with the characteristics of gifted individuals. Concordantly, applications that will support competence and talent development should be carried out. Considering the situation mentioned within the scope of the research, it is aimed to determine the effect of STEM activity on scientific creativity and critical thinking skills within the skills and cognitive achievement within the field of mental activity of gifted students. For this purpose, it was tried to support the development of the competence and ability areas of gifted students who can produce solutions to the scientific problems encountered, and who can use criteria such as scientific creativity, critical thinking, problem-solving, and originality in the process of producing solutions and who strive to put forward new designs by using scientific knowledge. On the other hand, the fact that activities will be carried out based on science-technology-engineering-mathematics understanding will also enable gifted students to grow up as "engineer students". It is thought that this situation can enable the training of individuals who can put forward original ideas, who can make entrepreneurial designs by assimilating the process of producing scientific solutions, and thus contribute to the economic and social status of our country.

STEM-BASED ACTIVITY AND SCIENTFIC CREATIVITY

The concept of scientific creativity, which is conceptually different from the concept of creativity, is influenced by values such as intelligence, knowledge, learning style, personality, and motivation (Hu & Adey, 2002), which are scientifically put into work at each stage from the definition of the problem to the design put forward for its solution (Samuels & Seymour, 2015) and the blending of the individual's knowledge from the scientific dimensions. Ambruso (2003) related the concept of scientific creativity with the scientific ability and scientific process and stated that scientific creativity has an important role in processes such as defining problems, establishing hypotheses, and conducting experiments, just like a scientist. Similarly, Lin, Hu, Adey & Shen (2003) mentioned the relationship between scientific creativity and talent and stated that creativity is based on scientific assumptions in terms of technique and knowledge. Zhang, Liu & Lin (2002) stated that the concept of scientific creativity is found in individuals who think about scientific dogmas and can take initiative and that it is the ability that is actively used in the problem-solving process. Samuels and Seymour (2015), who stated that STEM education has positive effects on scientific creativity and problem solving, stated that the basis of STEM education is to carry out applications through the problem, and in this process,

students' curiosity is attracted to the subject area and their scientific creativity is put to work and students can develop strategies in the dimension of solution. Hu and Adey (2002) mentioned that scientific creativity takes place at the intersection dimension of the integrity formed by the combination of science, technology, and other disciplinary, which are considered as separate clusters. In this sense, it is important to consider the dimensions of the interdisciplinary approach called STEM holistically in terms of the use and development of scientific creativity. Doppelt (2009) stated that this situation is achieved through a process consisting of 6 stages for the use and development of scientific creativity in STEM education. In the first stage, it is a case of determining the objectives of the design for the solution of the problem. To reveal the objectives of the design, it is necessary to reveal the problem in detail, determine the limitations, and make sense of the needs. In the second stage, it is a collection of information areas for the solution of the problem. Information for each of the STEM fields needs to be conceptualized and research resources need to be used appropriately to solve the problem. In the third stage, it is necessary to make inferences about the solution to the problem. At this stage, ideas that can be derived for the solution of the problem are put forward rather than the right or wrong idea. Solution proposals that can be produced from ideas are important for the next stage. In the fourth stage, it is a matter of choosing the optimal solution from the solution proposals put forward. The important thing is that the solution is aimed at the solution of the problem and that the advantages and disadvantages are evaluated holistically. In the fifth stage, it is a matter of selecting and creating the appropriate methods and techniques for the chosen solution path. From drawing the solution to creating the prototype, all processes occur in this process. In the last stage, it is necessary to evaluate whether the design is aimed at solving the problem. When all the steps are taken into consideration, it is seen how effective the engineering design process is on scientific creativity and that they have a structure that can be mapped as steps.

STEM-BASED ACTIVITY AND COGNITIVE ACHIEVEMENT

Cognitive achievement is an indicator of the competencies and competencies of individuals in the event, situation, or subject area and is expressed in the literature as academic achievement or success. Cognitive achievement can be based on a learning outcome, a goal, or a purpose, or it can be directed to a subject area. Therefore, the existence of knowledge, skills, and competence areas in cognitive achievement should not be forgotten. In other words, the cognitive achievement is not the answers given to the questions posed to the individual. Cognitive achievement is the recruitment of knowledge, skill areas, and competencies in the questions asked. In this sense, since the individual's success status in the relevant subject area will be quantitatively revealed in the evaluation of cognitive success, the measurement tool created to evaluate cognitive success should have competence in terms of hardware and content. In addition, accumulation, skill, and competence criteria should be taken into consideration in the applications carried out to improve the cognitive success of the individual (Lemelin et al., 2007).

When the literature on whether STEM education affects increasing the cognitive achievement of individuals by developing their knowledge, skill areas, and competencies is examined, the meta-analysis study conducted by Becker and Park (2011) reveals the relationship between STEM and academic achievement summarizes the situation. In the research conducted on the key concepts of STEM and cognitive achievement using various search engines, 28 studies were found. With the effect of the interdisciplinary understanding of STEM education, it has been revealed that meaningful differences occur in students' learning, affect skill development, and gain competence and thus provide the development of cognitive success. In addition, since STEM education provides a rich learning environment to the student, it is stated that it has a positive effect on interest, motivation, and attitude factors as well as cognitive achievement. Concordantly, it would not be wrong to say that the rich conceptuality and holistic features of STEM have a positive effect on cognitive achievement.

METHOD

RESEARCH DESIGN

This study was aimed to determine the effect of STEM activity designed for gifted students on students' scientific creativity and cognitive achievement. Depending on this purpose; (1) Application of pre-tests to determine the scientific creativity and cognitive achievement of gifted students, (2) Conducting the STEM activity process with the teaching material designed for gifted students, (3) Applying post-tests to determine the scientific creativity and cognitive achievement of gifted students at the end of the application process, and (4) Evaluating the effect of STEM activity on scientific creativity and cognitive achievement. In the realization of the relevant steps, the simple experimental method, which is one of the quantitative research approaches, was preferred. In simple experimental method research carried out on only a single research group without a control group, the situation of the group before the application process and the situation after the application process are evaluated by comparing them. Therefore, in the simple experimental method, the responsibilities fulfilled in the application process are evaluated (Trochim, 2001). Within the scope of the research, the expectation of evaluating the effect of the process by comparing the scientific creativity and cognitive achievement situations before the STEM activity with the teaching material designed for gifted students and the situations after the application process appropriated the use of the simple experimental method.

PARTICIPANTS

In the fall semester of the 2019-2020 academic year, it was carried out on a total of 24 students studying in the ITR (Individual Tw Program at the science and art center in the city center of Trabzon. In the conduct of the ITR Program on the students studying: (i) The preferred subject is given to the students at the 6th grade level as an achievement in the science course curriculum, (ii) The absenteeism problems of the students in other groups and the attendance status in the activities to be carried out in steps in the process is an important variable, and (iii) the teachers who are performing their teaching duties at science and art center are expressing that it would be appropriate to choose the ITR Program.

In the selection of the students studying in the ITR Program, all the students in the ITR program who are studying at the science and art center on the days and times determined by the researcher without any criteria are included in the research process. The information of the participants is presented in Table 1.

Table 1. *The Demographics of the Recruited Study Participants*

Participant	*Gender*	*Age*	*Grade Level*	*Participant*	*Gender*	*Age*	*Grade Level*
P1	Female	13	6th-grade level	P13	Male	13	6th-grade level
P2	Female	13	6th-grade level	P14	Male	14	6th-grade level
P3	Female	14	6th-grade level	P15	Male	14	6th-grade level
P4	Female	13	6th-grade level	P16	Male	13	6th-grade level
P5	Female	14	6th-grade level	P17	Male	14	6th-grade level
P6	Female	13	6th-grade level	P18	Male	13	6th-grade level
P7	Female	14	6th-grade level	P19	Male	14	6th-grade level
P8	Female	13	6th-grade level	P20	Male	13	6th-grade level
P9	Female	13	6th-grade level	P21	Male	13	6th-grade level
P10	Female	13	6th-grade level	P22	Male	14	6th-grade level
P11	Female	13	6th-grade level	P23	Male	13	6th-grade level
P12	Female	14	6th-grade level	P24	Male	14	6th-grade level

When examining Table 1, it is seen that the research was carried out with a total of 24 students studying in the ITR Program. The fact that the number of men and women in the student group is equal has been an important parameter for the gender variable to affect the results, although it is a situation that occurred randomly.

DATA COLLECTION TOOLS

While the "Scientific Creativity Scale" was used to determine the effect of the STEM activity designed for gifted students on the scientific creativity variable of the students, the "Academic Achievement Test" developed in the preferred subject area was used in the context of the research to determine the effect on cognitive achievement.

SCIENTIFIC CREATIVITY SCALE

For the scientific creativity dimension, which is one of the variables to be evaluated within the scope of the research, the scale developed by Hu and Adey (2002) and adapted into Turkish, and the study of its use was carried out by Deniş-Çeliker and Balım (2012). This scale consists of 7 open-ended questions and 7 sub-dimensions. The first question is about different uses, the second question is about problem discovery, the third question is about product development, the fourth question is about imagination, the fifth question is about problem-solving, the sixth question is about creative ability, and the seventh question is about product design. In each question, gifted students were expected to answer the problem situation using their scientific creativity. When the content of the questions was examined, the quality of the answer was examined instead of being true or wrong. In the qualification examination process, fluency, flexibility, and originality criteria were taken into consideration.

COGNITIVE ACHIEVEMENT

For the cognitive achievement dimension to be evaluated within the scope of the research, the "Alternative Energy Sources Success Test" developed by Ergin (2010) was used. The achievement test consists of a total of 20 questions, 16 of which are multiple choice and 4 of which are open-ended. In multiple-choice questions, 5 points were given for each correct answer, while in open-ended questions, evaluation was provided over 5 points depending on the theme creation process. In the creation of the content of the questions, the achievements of the curriculum of the science course were taken into consideration and the aim of the curriculum was focused on the acquisitional objectives that the curriculum aimed to provide to the students.

PROCEDURES

For the scientific creativity variable, the measurement tool developed by Hu and Adey (2002) and adapted to Turkish by Denis-Celiker and Balim (2012) was used. In the applications carried out in the form of pre-test – post-test, data collection was provided individually to prevent students from being affected by each other. Students were given approximately 30 minutes to complete the data collection tool, which consisted of a total of 7 questions. It is stated that the accuracy or inaccuracy criterion is not sought in the answers they will give in the measurement tool, and therefore they should answer using their scientific knowledge.

For the cognitive achievement variable, the "Alternative Energy Sources Success Test" developed by Ergin (2010) was used. Students were given 25 minutes in the process of collecting data with the measurement tool, 16 of which consisted of multiple choice and 4 open-ended questions. It is stated that the first 16 questions will be scored as correct or incorrect answers and the last 4 questions will be evaluated depending on their scientific knowledge and mental models. Students were given 25 minutes in the process of collecting data with the measurement tool, 16 of which consisted of multiple choice and 4 open-ended questions. It is stated that the first 16 questions will be scored as correct or incorrect answers and the last 4 questions will be evaluated depending on their scientific knowledge and mental models.

On the other hand, the applications carried out with the students in the ITR Program were carried out by the vertical enrichment strategy and as an educational model, it was determined that the features of the grid model were more suitable for STEM application.

DATA ANALYSIS

In the process of analyzing the quantitative data collected in the form of pre-test and post-test, SPSS 25.0 package program was used. In the analysis process, it was first determined which test method would be used in the analysis of the data obtained from each measurement tool. In this context, normality analysis was used. In the normality analysis, the Kolmogorov-Smirnov test is used if the number of participants is greater than 50 and the Shapiro-Wilk test is used if the number of participants is less than 50 (Razzali & Wah, 2011). Within the scope of the study, since the sample group was 24 people, it was decided to use the Shapiro-Wilk test to determine whether the data were distributed normally. As a result of the Shapiro-Wilk test, it was taken into consideration that if the normality value of the pre-test and post-test result of a single sample group is less than .05, the "Wilcoxon Marked Rows Test", which is one of the nonparametric tests, and if it is greater than .05, the analysis should be carried out with the "Associated Samples t-Test", which is one of the parametric tests. The results of the Shapiro-Wilk test of the difference scores that occurred by considering the difference between the final test scores and the preliminary test scores to evaluate the normal distribution status of the variables to be examined within the scope of the research are presented in Table 2.

Table 2. *Shapiro-Wilk Test Results for the Variables Considered in the Research*

		Shapiro-Wilk		
Variable	*Sub-Dimension*	*Statistics*	*sd*	*Significance*
Scientific Creativity	Different Use	,937	24	,136
	Exploring the Problem	,918	24	,060
	Product Development	,893	24	,010
	Imagination	,845	24	,020
	Solving the Problem	,867	24	,000
	Creative Talent	,681	24	,000
	Product Design	,865	24	,000
	Total	,986	24	,615
Cognitive Achievement	-	,975	24	,798

When examining Table 2, the variables considered within the scope of the research, scientific creativity, and cognitive achievement difference scores; "Associated Samples t-Test" was used in the analysis process of the relevant variables depending on the normality value of the result being greater than .05 in the sub-dimensions of scientific creativity variable and exploration of the problem, while "Wilcoxon Marked Sequences Test" was used in the analysis process of the relevant variables depending on the normality value of the result being less than .05 in the dimensions of product development, imagination, problem-solving, creative ability and product design. In the normality evaluation of the total difference scores of the scientific creativity variable, it was decided to use the "Associated Samples t-Test" in the analysis process of the relevant variable depending on the fact that the relevant result was greater than .05.

Similarly, in the normality evaluation of the cognitive achievement difference scores, which is the other variable considered within the scope of the research, it was decided to use the "Associated Samples t-Test" in the analysis process of the relevant variable depending on the fact that the relevant result was greater than .05. In the analysis procedures carried out, Cohen's D effect size was calculated depending on the fact that the value obtained from the Shapiro-Wilk test was greater than .05 and the value obtained from the associated samples t-test applied depending on this size was significant. In the interpretation made; If the value is less than .15, it is considered to be insignificant, between .15 and .40 it is considered to be at a small level, between .40 and .75 it is moderate, between .75 and 1.10 it is considered to be at a wide level, between 1.10 and 1.45 it is considered to be at a very wide level, and if it is greater than 1.45, it is considered to be effective at a perfect level (Dincer, 2014).

VALIDTY AND RELIABLITY

The validity and reliability analyses of the measurement tools were carried out by applying the scientific creativity scale and cognitive achievement test on another group (n=12) with similar qualifications with the sample group. In the validity factor of the measurement tools, content, predictive, construct and face validities were taken into consideration. Cronbach Alpha technique was used in the reliability analysis of the measurement tools. The value of scientific creativity scale determined by Cronbach Alpha technique was calculated as .80 and the value of cognitive achievement test determined by Cronbach Alpha technique was calculated as .71.

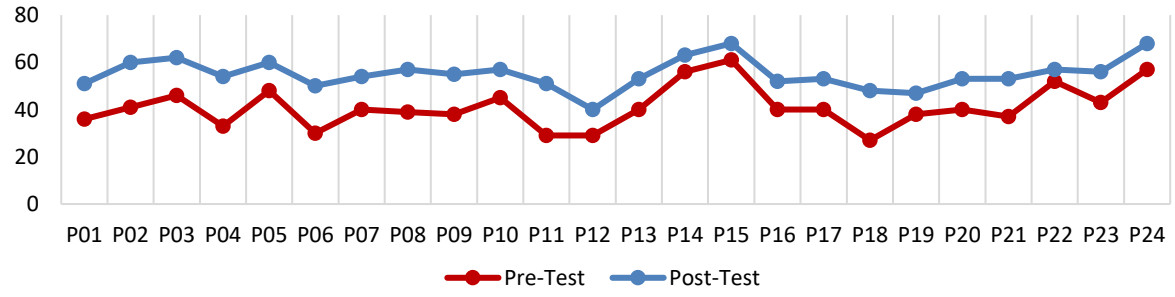
FINDINGS/RESULTS

The effect of the STEM activity designed for gifted students on the scientific creativity variable of the students and the effect on cognitive success are discussed separately and explained below.

THE EFFECT OF STEM-BASED ACTIVITY ON SCIENTIFIC CREATIVITY

To determine the effect of STEM-based activity designed for gifted students on scientific creativity, the data of the total pre-test scores and total post-test scores obtained by the participants from the data collection tool consisting of seven questions are presented in Chart 1.

Chart 1. *Participants' Score Values from The Scientific Creativity Scale*



As explained in Chart 1, it is seen that the total post-test score values obtained by the participants from the scientific creativity scale are higher than the total pre-test score values. The fact that this situation is in favour of the post-test test can be accepted as an indication that the practices carried out produce meaningful results. To evaluate whether the scores obtained by the participant group from the scientific creativity scale produced statistically significant results, the dependent t-test was applied considering the normal distribution of the data, and the results obtained were presented in Table 3.

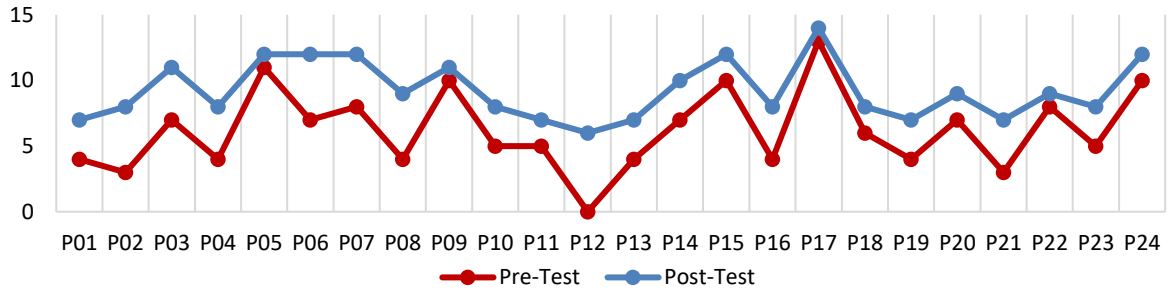
Table 3. *Results of Dependent T-Test Regarding Students' Scientific Creativity Scores*

Scientific Creativity	*n*	$\bar{X}$	*ss*	*sd*	*t*	*p*
Pre-Test	24	41,04	8,92	23	14,82	.00
Post-Test	24	55,08	6,37			

When examining Table 3, it is revealed that there is a significant difference in the scientific creativity of the participants after the implementation of the STEM-based activity designed for gifted students, t(23)=14,82, p<.05. On the other hand, Cohen's D effect size was calculated and found to be 3.03 to determine the difference in significance between the participants' pre-test and post-test scores. It can be stated that the difference is due to excellent STEM-based activity.

The first sub-dimension of the scientific creativity scale is different use. The data of the pre-test scores and post-test scores obtained by the participants depending on their answers to the first question of the measurement tool are presented in Chart 2.

Chart 2. *Participants' Score Values from The Different Use Sub-Dimension*



As explained in Chart 2, it is seen that the post-test score values obtained by the participants from the different usage sub-dimensions are higher than the pre-test score values. The fact that this situation is in favor of the post-test can be accepted as an indication that the practices carried out produce meaningful results. To evaluate whether the scores obtained by the participant group from different use sub-dimension of the scientific creativity scale produced statistically significant results, the dependent t-test was applied considering the normal distribution of the data, and the results obtained were presented in Table 4.

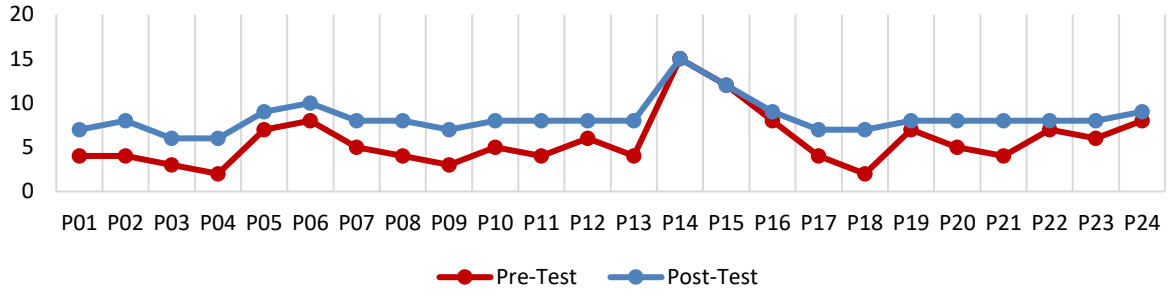
Table 4. *Results of Dependent T-Test Regarding Students' Different Use Scores*

Different Use	*n*	$\bar{X}$	*ss*	*sd*	*t*	*p*
Pre-Test	24	6,20	3,05	23	10,42	.00
Post-Test	24	8,58	2,28			

When examining Table 4, it is revealed that there is a significant difference in the different use of the participants after the application of STEM activity to the group, t(23)= 10,42, p<.05. On the other hand, Cohen's D effect size was calculated and found to be 2.13 to determine the difference in significance between the participants' pre-test and post-test scores. It can be stated that the difference is due to excellent STEM-based activity.

The second sub-dimension of the scientific creativity scale is exploring the problem. The data of the pre-test scores and post-test scores obtained by the participants depending on their answers to the second question of the measurement tool are presented in Chart 3.

Chart 3. *Participants' Score Values from The Exploring the Problem Sub-Dimension*



As explained in Chart 3, it is seen that the post-test score values obtained from exploring the problem sub-dimension of all other participants, except for the score values of the participant with the code P15, are higher than the pre-test score values. To evaluate whether the scores obtained by the participant group from exploring the problem sub-dimension of the scientific creativity scale produced statistically significant results, the dependent t-test was applied considering the normal distribution of the data, and the results obtained were presented in Table 5.

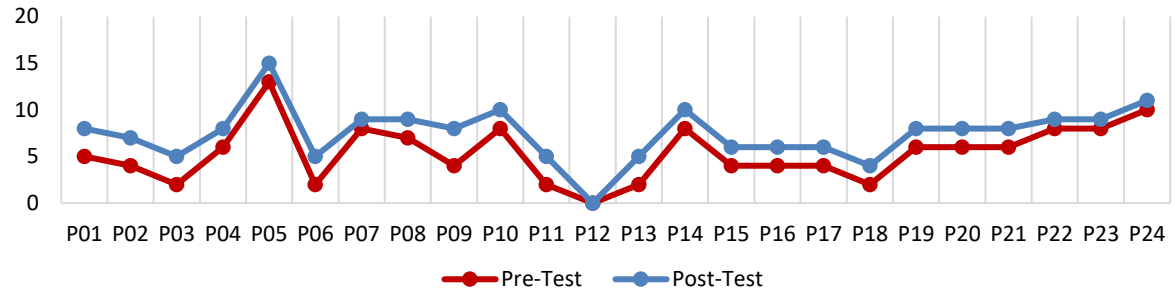
Table 5. *Results of Dependent T-Test Regarding Students' Exploring the Problem*

Exploring the Problem	*n*	$\bar{X}$	*ss*	*sd*	*t*	*p*
Pre-Test	24	5,70	3,02	23	9,13	.00
Post-Test	24	8,33	1,88			

When examining Table 5, it is revealed that there is a significant difference in exploring the problem of the participants after the application of STEM activity to the group, t(23)= 10,42, p<.05. On the other hand, Cohen's D effect size was calculated and found to be 1.86 to determine the difference in significance between the participants' pre-test and post-test scores. It can be stated that the difference is due to excellent STEM-based activity.

The third sub-dimension of the scientific creativity scale is product development. The data of the pre-test scores and post-test scores obtained by the participants depending on their answers to the third question of the measurement tool are presented in Chart 4.

Chart 4. *Participants' Score Values from The Product Development Sub-Dimension*



As explained in Chart 4, it is seen that the post-test score values obtained from the product development sub-dimension of all other participants, except for the score values of the participant with the code P12, are higher than the pre-test score values. To evaluate whether the scores obtained by the participant group from the product development sub-dimension of the scientific creativity scale produced statistically significant results, the Wilcoxon signed-ranks test was applied considering the non-normal distribution of the data, and the results obtained were presented in Table 6.

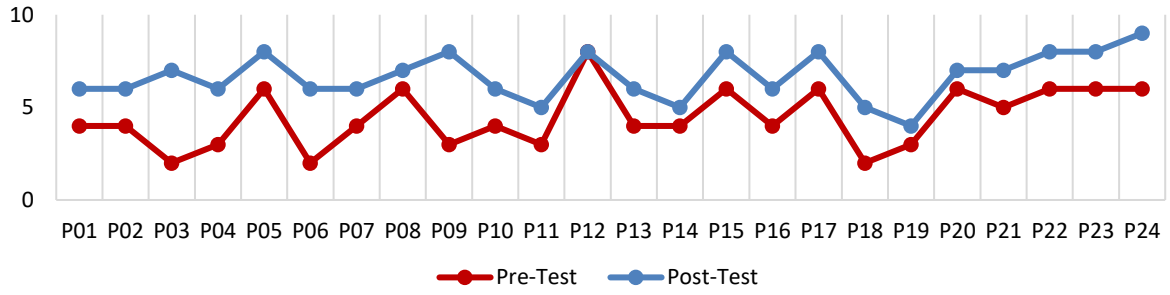
Table 6. *Results of Wilcoxon Signed-Ranks Test Regarding Students' Product Development*

Product Development	*n*	*Mean Rank*	*Sum of Ranks*	*z*	*p*
Negative Ranks	0	,00	,00		
Positive Ranks	23	12,00	276,00	-4,28	.00
Ties	1				

When examining Table 6, it is revealed that there is a significant difference in the product development of the participants after the STEM-based activity designed for gifted students is applied to the group (z=4,28, p<.05). When the pre-test and post-test scores of the participants for the product development sub-dimension were evaluated, it was determined that the significant difference that occurred was in favor of positive ranks, that is, the post-test scores.

The fourth sub-dimension of the scientific creativity scale is imagination. The data of the pre-test scores and post-test scores obtained by the participants depending on their answers to the fourth question of the measurement tool are presented in Chart 5.

Chart 5. *Participants' Score Values from The Imagination Sub-Dimension*



As explained in Chart 5, it is seen that the post-test score values obtained from the imagination sub-dimension of all other participants, except for the score values of the participant with the code P12, are higher than the pre-test score values. To evaluate whether the scores obtained by the participant group from the imagination sub-dimension of the scientific creativity scale produced statistically significant results, the Wilcoxon signed-ranks test was applied considering the non-normal distribution of the data, and the results obtained were presented in Table 7.

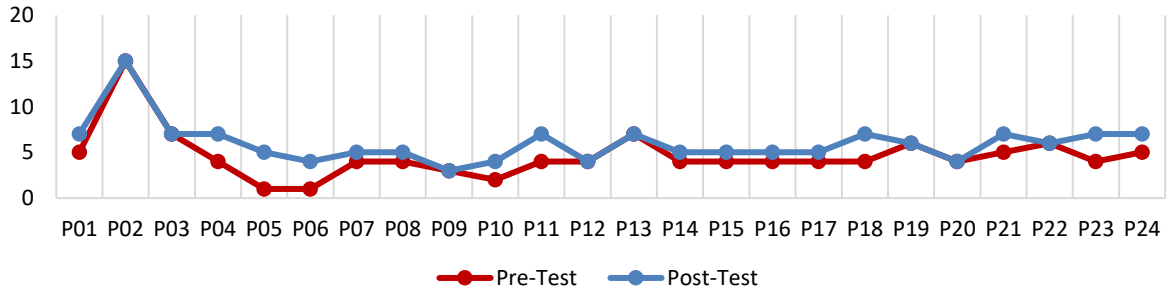
Table 7. *Results of Wilcoxon Signed-Ranks Test Regarding Students' Imagination*

Imagination	*n*	*Mean Rank*	*Sum of Ranks*	*z*	*p*
Negative Ranks	0	,00	,00		
Positive Ranks	23	12,00	276,00	-4,29	.00
Ties	1				

When examining Table 7, it is revealed that there is a significant difference in the imagination of the participants after the STEM-based activity designed for gifted students is applied to the group ($z=4,29$, $p<.05$). When the pre-test and post-test scores of the participants for the imagination sub-dimension were evaluated, it was determined that the significant difference that occurred was in favor of positive ranks, that is, the post-test scores.

The fifth sub-dimension of the scientific creativity scale is solving the problem. The data of the pre-test scores and post-test scores obtained by the participants depending on their answers to the fifth question of the measurement tool are presented in Chart 6.

Chart 6. *Participants' Score Values from The Solving the Problem Sub-Dimension*



As explained in Chart 6, it is seen that the post-test score values obtained from solving the problem sub-dimension of all other participants, except for the score values of the participants with the codes P02, P03, P09, P12, P13, P19, P20, and P22, are higher than the pre-test score values. To evaluate whether the scores obtained by the participant group from solving the problem sub-dimension of the scientific creativity scale produced statistically significant results, the Wilcoxon signed-ranks test was applied considering the non-normal distribution of the data, and the results obtained were presented in Table 8.

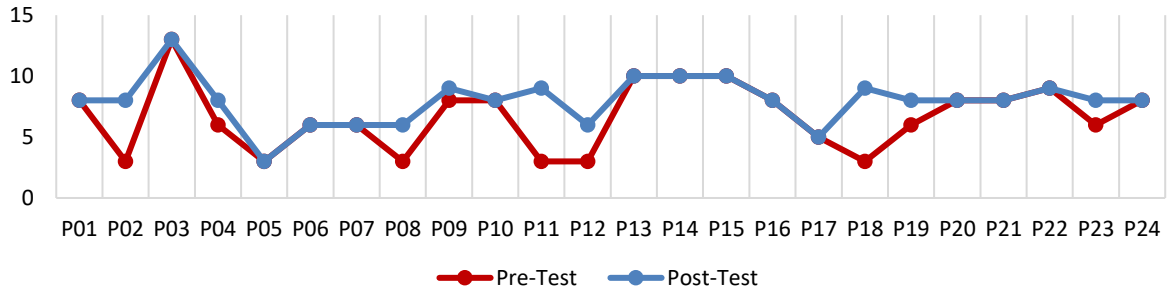
Table 8. *Results of Wilcoxon Signed-Ranks Test Regarding Students' Solving the Problem*

Solving the Problem	*n*	*Mean Rank*	*Sum of Ranks*	*z*	*p*
Negative Ranks	0	,00	,00		
Positive Ranks	16	8,50	136,00	-3,55	.00
Ties	8				

When examining Table 8, it is revealed that there is a significant difference in solving the problem of the participants after the STEM-based activity designed for gifted students is applied to the group (z=3,55, p<.05). When the pre-test and post-test scores of the participants for solving the problem sub-dimension were evaluated, it was determined that the significant difference that occurred was in favor of positive ranks, that is, the post-test scores.

The sixth sub-dimension of the scientific creativity scale is creative talent. The data of the pre-test scores and post-test scores obtained by the participants depending on their answers to the sixth question of the measurement tool are presented in Chart 7.

Chart 7. *Participants' Score Values from The Creative Talent Sub-Dimension*



As explained in Chart 7, it is seen that the post-test score values obtained from the creative talent sub-dimension of all other participants, except for the score values of the participants with the codes P01, P03, P05, P06, P07, P10, P13, P14, P15, P16, P17, P20, P21, P22, and P24, are higher than the pre-test score values. To evaluate whether the scores obtained by the participant group from the creative talent sub-dimension of the scientific creativity scale produced statistically significant results, the Wilcoxon signed-ranks test was applied considering the non-normal distribution of the data, and the results obtained were presented in Table 9.

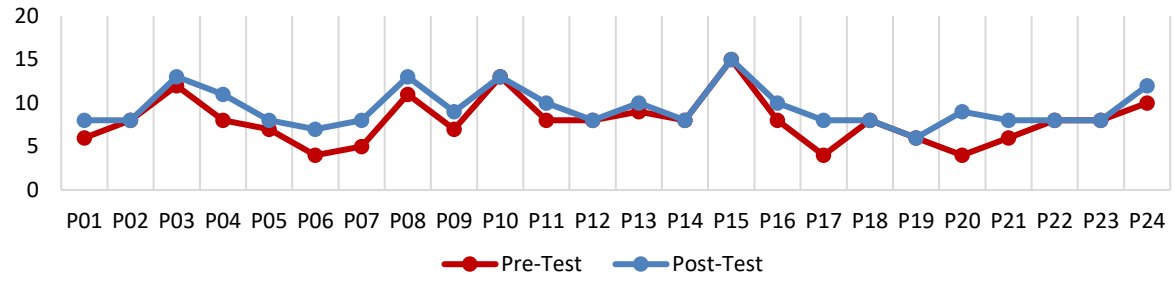
Table 9. *Results of Wilcoxon Signed-Ranks Test Regarding Students' Creative Talent*

Creative Talent	*n*	*Mean Rank*	*Sum of Ranks*	*z*	*p*
Negative Ranks	0	,00	,00		
Positive Ranks	9	5,00	45,00	-2,68	.00
Ties	15				

When examining Table 9, it is revealed that there is a significant difference in the creative talent of the participants after the STEM-based activity designed for gifted students is applied to the group (z=2,68, p<.05). When the pre-test and post-test scores of the participants for creative talent sub-dimension were evaluated, it was determined that the significant difference that occurred was in favor of positive ranks, that is, the post-test scores.

The seventh sub-dimension of the scientific creativity scale is product design. The data of the pre-test scores and post-test scores obtained by the participants depending on their answers to the seventh question of the measurement tool are presented in Chart 8.

Chart 8. *Participants' Score Values from The Product Design Sub-Dimension*



As explained in Chart 8, it is seen that the post-test score values obtained from the product design sub-dimension of all other participants, except for the score values of the participants with the codes P02, P10, P12, P14, P15, P18, P19, P22, and P23, are higher than the pre-test score values. To evaluate whether the scores obtained by the participant group from the product design sub-dimension of the scientific creativity scale produced statistically significant results, the Wilcoxon signed-ranks test was applied considering the non-normal distribution of the data, and the results obtained were presented in Table 10.

Table 10. *Results of Wilcoxon Signed-Ranks Test Regarding Students' Product Design*

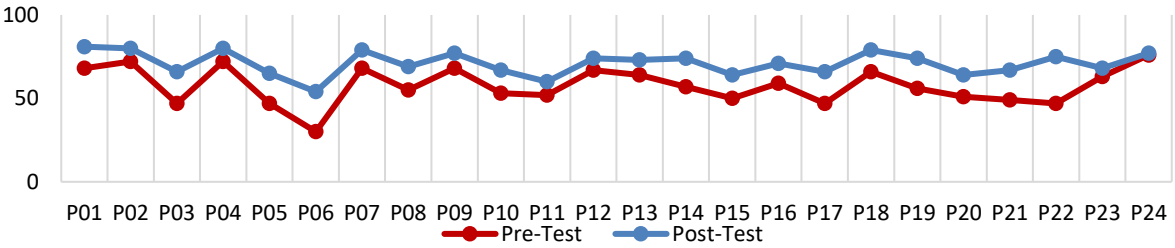
Product Design	*n*	*Mean Rank*	*Sum of Ranks*	*z*	*p*
Negative Ranks	0	,00	,00		
Positive Ranks	15	8,00	120,00	-3,45	.00
Ties	9				

When examining Table 10, it is revealed that there is a significant difference in the product design of the participants after the STEM-based activity designed for gifted students is applied to the group (z=3,45, p<.05). When the pre-test and post-test scores of the participants for product design sub-dimension were evaluated, it was determined that the significant difference that occurred was in favor of positive ranks, that is, the post-test scores.

THE EFFECT OF STEM-BASED ACTIVITY ON COGNITIVE ACHIEVEMENT

To determine the effect of STEM-based activity designed for gifted students on cognitive achievement, the data of the total pre-test scores and total post-test scores obtained by the participants from the data collection tool consisting of twenty questions are presented in Chart 9.

Chart 9. *Participants' Score Values from The Cognitive Achievement*



As explained in Chart 9, it is seen that the total post-test score values obtained by the participants from the cognitive achievement test are higher than the total pre-test score values. The fact that this situation is in favor of the post-test test can be accepted as an indication that the practices carried out produce meaningful results. To evaluate whether the scores obtained by the participant group from the cognitive achievement test produced statistically significant results, the dependent t-test was applied considering the normal distribution of the data, and the results obtained were presented in Table 11.

Table 11. *Results of Dependent T-Test Regarding Students' Cognitive Achievement Scores*

Cognitive Achievement	*n*	$\bar{X}$	*ss*	*sd*	*t*	*p*
Pre-Test	24	57,66	10,94	23	10,64	**.00**
Post-Test	24	71,00	7,06			

When examining Table 11, it is revealed that there is a significant difference in the cognitive achievement of the participants after the implementation of the STEM-based activity designed for gifted students, t(23)=10,64, p<.05. On the other hand, Cohen's D effect size was calculated and found to be 2.17 to determine the difference in significance between the participants' pre-test and post-test scores. It can be stated that the difference is due to **excellent** STEM-based activity.

DISCUSSION, CONCLUSION AND IMPLICATIONS

When the effect of STEM-based activity designed for gifted students on scientific creativity is evaluated; It is seen that the post-test scores obtained by the research group from the scientific creativity scale differ significantly from the pre-test scores both holistically and in all sub-dimensions of scientific creativity (different use, exploring the problem, product development, imagination, solving the problem, creative talent, product design). It is thought that the nature of STEM-based activity and the steps in the engineering design process affect the emergence of this situation. Considering that the concept of scientific creativity is influenced by values such as intelligence, knowledge, learning style, personality, and motivation (Hu & Adey, 2002), which is scientifically employed at every stage from the definition of the problem to the design put forward for its solution (Samuels & Seymour, 2015) and that the accumulation of knowledge of the individual is blended from the scientific dimensions; It is obvious to expect that the STEM-based activity process, which consists of various steps and is carried out to solve the scientific problem, will affect scientific creativity. According to Doppelt (2009), in the STEM-based activity process consisting of six steps, scientific creativity is used in determining the design objectives for the solution of the problem, in collecting the information areas for the solution of the problem, in making the inferences for the solution of the problem, in choosing and creating methods and techniques appropriate to the solution and in the solution of the problem of the design. When the literature on the effect of STEM-based activity on scientific creativity is examined; Samuels and Seymour (2015) emphasized that solution strategies can be developed by using their scientific creativity by ensuring that STEM education is carried out on a problem basis and that students' curiosity is attracted. Similarly, in the research conducted by Hu and Adey (2002), they mentioned that scientific creativity takes place at the intersection dimension of the integrity formed by the combination of science, technology, and other disciplinary fields. The research conducted by Ayverdi (2018) aimed to determine the effect of STEM-based activity for gifted students on scientific creativity, scientific process, and engineering skills. As a result of the research, it was emphasized that STEM-based activity for gifted students contributed to the scientific creativity and skill development of students. As can be seen from the literature reviews conducted, STEM-based activity positively affects scientific creativity. It was expected to have a positive effect within the scope of the research and once again revealed the effect of STEM-based activity on scientific creativity. Based on the data obtained from both the literature and this research, it would not be wrong to say that STEM-based activity makes a significant difference in the scientific creativity of gifted students.

When the effect of STEM-based activity designed for gifted students on cognitive achievement is evaluated; It is seen that the post-test scores obtained from the cognitive achievement test of the research group differ significantly from the pre-test scores. It is thought that STEM-based activity has the effect of directing the student to research inquiry and providing meaningful-permanent learning in the emergence of this situation. Considering that the concept of cognitive achievement is based on a goal or a purpose and that includes accumulation, skill, and competency criteria (Lemelin et al., 2007), it is expected that the STEM-based activity process, which consists of various steps and performs

various tasks towards a goal, will affect cognitive achievement. When the literature on whether STEM education affects increasing the cognitive achievement of individuals by developing their knowledge, skill areas, and competencies is examined, Ceylan (2014) examined the effect of STEM-based activity on students' success, creativity and problem solving, and found that the cognitive achievement levels of students in the experimental group who received education depending on STEM-based activity were higher than those of students in the control group has been revealed to be high. In the research conducted by McKinnon (2018) aimed to examine the effect of STEM education on the success of their students, it was revealed that the reading and mathematics achievement results of students in some schools where STEM education was given differed significantly from those of students in schools without STEM education. As a result of the research, it was emphasized that project-based STEM teaching has a positive effect on student success. Becker and Park (2011), who wanted to evaluate the researches with meta-analysis technique, investigated the relationship between STEM and academic achievement. As a result of the research, it was revealed that with the effect of the interdisciplinary understanding of STEM education in the researches conducted on STEM and cognitive achievement, meaningful differences occurred on the learning of the students, affected the skill development and gained competence and thus enabled the development of cognitive achievement. Concordantly, it has been shown that the conceptuality and holistic features of STEM have a positive effect on cognitive achievement. As can be seen from the literature reviews conducted, STEM-based activity has a positive effect on cognitive achievement. The positive effect of the research was expected and once again revealed the effect of STEM-based activity on cognitive achievement. Based on the data obtained from both the literature and this research, it would not be wrong to say that STEM-based activity makes a significant difference in the cognitive achievement of gifted students.

IMPLICATIONS

- STEM-based activities effect scientific creativity because STEM-based activities are carried out in the form of consecutive steps and there are competencies such as thinking differently, being creative, solving problems, and creating products in the content of these steps. Therefore, it is recommended to carry out STEM-based activities to develop the scientific creativity of gifted students. On the other hand, it is recommended that researchers who want to conduct research to examine the effect of STEM-based activities on the skills of gifted students should not ignore the scientific creativity factor. Concordantly, the predictive effect of scientific creativity of gifted students on other skills can be investigated.
- Considering the effect of STEM-based activities on cognitive achievement, it is recommended to use STEM-based activities in the subject areas aimed at increasing cognitive achievement. On the other hand, activities can be carried out by choosing subjects suitable for the nature of STEM-based activities instead of the subject chosen as the subject within the scope of the research.
- It is recommended to carry out studies that evaluate the effect of STEM-based activities designed for gifted students on areas such as critical thinking, problem solving, analytical thinking and scientific process skills that students have.

AUTHOR CONTRIBUTIONS

- First author have made substantial organizing the research process and have given final approval of the version to be published.
-The second author have made substantial proofreading process, substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data and have been involved in drafting the manuscript or revising it critically for important intellectual content.

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Development and Validation of the Professional Development Needs Scale: Evidence from Turkish School Principals

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Abstract

This study aims to develop a Professional Development Needs of School Principals Scale (PDNSP) to measure in-service training needs of school principals in Turkiye. The Turkish Ministry of National Education launched a new plan called Education Vision 2023 in November 2018. The Plan has emphasized the importance of supporting both administrative and leadership skills of school principals. The PDNSP was developed based on this policy reform and the current study presents validity and reliability evidence of the scale. The PDNSP was developed based on this policy reform, and the current study presents validity and reliability evidence of the scale. The exploratory, confirmatory factor analysis, and reliability analysis were conducted to evaluate the psychometric properties of the scale. The results suggest that the PDNSP is a reliable and valid tool to assess the professional development needs of school principals. Furthermore, the findings show that the Turkish school principals require professional development in specific areas such as financial management, leadership capacity, and vision and values.

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INTRODUCTION

In contemporary education discourse, educators, curriculum developers, principals, and teachers are grappling with a common question: How can we effectively prepare students to thrive in the rapidly changing world of the 2040s or 2050s? The Australian Curriculum has boldly declared its commitment to "Preparing for a world yet to be imagined!" (EduGrowth, 2021), highlighting the unpredictability of future career paths and the need to equip students with adaptable skills rather than solely focusing on specific subject matter. Consequently, this ongoing debate has brought about a more complex approach to teaching and learning, as compared to traditional methods. As a result, the discussion has shifted towards the crucial role of educational and administrative elements in addressing the needs of learners in the contemporary age.

The quality of school organization and student learning are greatly impacted by effective leadership (Leithwood et al., 2006). The research showed that the persistence and motivation of effective teachers are highly related to the school leaders' effectiveness (Leithwood et al., 2004). Bredeson and Johansson (2000) proved that principals significantly influence teachers' professional development. Similarly, educational administration scholars mentioned that the school's and teachers' performance are also positively associated with the leadership skills, instruction, content, curriculum, and pedagogical knowledge of school principals (Radinger, 2014; Spillane, 2006; Wahlstrom & Louis, 2008). The way of reaching the ambitions of any educational reform or reform initiatives, the key roles depend on not only the characteristics of teachers but also the characteristics of school principals (Dempster, 2001; Pont et al., 2008; Sanders, 2014). Lambert (2005) defined continuously high-performing schools as "broad-based, skillful participation in the work of leadership" (*p*. 63). Fullan (2000) asserts that every improving school has principals who have the skills to lead the improvement. These principals' strategy of being frequently in classrooms and providing detailed feedback on the instructional practices returns to improving instruction and teacher self-efficacy (Freedman, 2003; Tschannen-Moran & Hoy, 2001). In other words, leadership has a key role in affecting the teacher's behavior directly, which, in turn, affects student success (Louis, et al., 2010; Teague & Anfara, 2012). For long before, many scholars have seen effective leadership as a "path" or find a "mediated" role to reach student achievement through leadership capacity (e.g., Bossert et al., 1982; Hallinger & Heck, 2002; Leithwood et al., 2010; Youngs & King, 2002). This means the school principals' leadership behavior is the second most crucial element influencing the students' academic life and outcomes (Bush, 2018).

Societies dealing with new challenges like immigration, labor market economy, disasters, new technologies, and change and development of knowledge expect different goals to be achieved by the schools (Dempster, 2001; Pont et al., 2008). The schools feel the pressure under these circumstances, and thus, the school principals. They must adapt to new pressure on the changing world and make a difference to succeed in the challenge created by the new demands. Widely cited research such as Marzano et al. (2005), Leithwood et al. (2008), and Day et al. (2009) proposed a long list of leadership behaviors of the school principals making a difference. In the last two decades, principals seem to be change agents (Provost et al., 2010), and their traditional managing role has shifted to different leadership roles, such as transformational leadership (Bass & Avolio, 1995; Leithwood & Jantzi, 2005), instructional leadership (Bolden, 2011; Kempster et al., 2014), social justice leadership (Brooks et al., 2007), and distributed leadership (Heck & Hallinger, 2009). All these roles bring some demanding responsibilities and accountability roles for principals, which lead to increasing kinds and numbers of professional development desires. In this context, the present study is focused on the professional development needs of school principals.

TURKISH CONTEXT AND THE NEW EDUCATION PLAN

The Turkish education system has almost 1,2 million teachers, 19 million students, and 65 thousand schools (MoNE, 2022). The school principals have to have a higher education degree and

formerly teachers at public schools (to have at least two years of teaching experience) (Millî Eğitim Bakanlığına Bağlı Eğitim Kurumlarına Yönetici Seçme ve Görevlendirme Yönetmeliği, 2021). The candidates of principals should enter the written and oral exams. The candidates with the highest scores are assigned the needed schools accordingly.

The challenges of Turkish school principals' have been vastly discussed in the literature. Recently, as a new global problem, Syrian refugees coming with trauma and depression, bringing different cultural frameworks, and having language barriers create difficulty in managing the schools (Aydin & Kaya, 2019; Tamer, 2017). This problem creates a more demanding test for novice principals. They face not only refugee challenges in schools but also the problems of negative parental attitudes towards school, syndicalism, communication barriers with teachers, and undesired student behaviors (Bayar, 2016). Adopting new technologies is another struggle of the principals. A comprehensive study in Istanbul showed that almost half of the principals were described as low-profile technology leadership with a weak interest in information and communication technologies (Banoglu, et al., 2016). Turkish principals were also found insufficient to show instructional leadership behaviors, including change management, enhancing teacher professional development, creating a positive learning environment, and collaborating with teachers (Kalman & Arslan, 2016). They were also found to devote less time and effort to educational and instructional work (Gumuseli, 2009). Moreover, principals struggle with country-specific system challenges like large-scale, top-down educational changes and cultural difficulties. Kondakci et al. (2019) concluded that principals are reluctant in leadership functions such as finding resources, making preparations, and guiding teachers to implement changes. In addition, the lack of training and support and the limited autonomy given to schools are considered as main problems of the Turkish educational administration system (Arar et al., 2018). From a more cultural perspective, school principals in Turkiye are prone to decide alone, which prevents them from creating a communicative and collaborative organizational culture. Therefore, research indicated that the organizational climate of Turkish schools makes school principals feel lonely and need support in the school's leadership (Korumaz, 2016). In addition to these difficulties, gender is another challenging factor for female principals in some parts of the country (Celikten, 2005). The literature of Turkish principals reported that some of the challenges increase professional development needs. However, the number of comprehensive studies that worked specifically on the principals' professional development needs is limited.

Despite the notable effort put forth to develop a national standard for teacher education and general competencies by the Ministry of National Education (MoNE) in 2017, there has yet to be any significant work on establishing national standards for school principals and educational leadership in Turkiye. To address this gap, the MoNE has launched the Education Vision 2023 plan, which calls for changes and improvements to the school system across 17 chapters. The first five chapters of the plan focus on education management, including data-based management systems, measurement and evaluation, human resource development and management, financing of schools, and supervision and institutional guidance. The following five chapters address the most pressing challenges facing the education system, such as psychological counseling, special education, foreign language education, digital content, and transformation of the learning process. The remaining chapters are dedicated to goals from early childhood to secondary education. Throughout the plan, particular attention is given to the importance of school principals and teachers, and the quality of their work. This research serves as a foundation for planning and decision-making concerning the responsibilities and needs of school principals under the Education Vision 2023. The study aims to develop a scale that can be used to comprehend the professional development needs of school principals.

RESEARCH CONTEXT

A noteworthy number of studies in the literature focus on the professional development needs of school principals. Their needs show a range of knowledge levels to a practical level as well as developing attitudes and belief systems on different concepts. DiPaola and Walther-Thomas (2003)

stated that principals in Florida need to have a comprehension of the laws regarding students with disabilities educational rights. Hong Kong principals reported their professional needs as empowering middle-tier leaders, motivating low-performing staff, practicing financial management techniques, improving the skills of dealing with illegal issues in school management, and developing instructional leadership skills (Ng & Szeto, 2016). Nigerian principals felt the professional development needs of communication, instructional supervisory, ICT development, and disciplinary skills (Peretomode & Dinzei, 2019). Ukrainian principals similarly desired to develop ICT skills (Mukan et al., 2017). Deutch principals reported a need for support in stimulating the teachers' motivation to learn and develop strategies to make a ground for the teacher professional development process (Gaikhorst et al., 2019). Virginia principals also reported their professional development needs in relation to instructional leadership; specifically, they desire to develop skills to make their teachers be trained in research-based instructional methods and increase the educational attainments of students with disabilities and living in poverty (Keith, 2008). Like the Virginia principals, the principals of rural schools in the USA needed professional development programs that could help them guide school reform and reach higher standards of student achievement (Salazar, 2007). Darling-Hammond et al. (2009) highlighted that effective leadership training programs that consider the professional needs of American principals were not widely available and yielded school improvement efforts suffer "in part due to a lack of support for developing such leadership" (*p*. vii).

School principals, as official administrative leaders, are expected to fulfill a variety of roles and responsibilities (DiPaola & Hoy, 2007). Apart from their day-to-day tasks, they are required to promote a school environment that supports continuous improvement. Management quality compasses a range of skills, competencies, and motivation. Accordingly, principals need to act efficiently and implement practices such as managing physical and human resources, collaborating with teachers, and creating healthy learning environments to enhance and deepen their professional skills (Elmore, 2000; Gaikhorst et al., 2019). Although some studies have explored the roles of school principals in school effectiveness, less is known about how to support them in developing new opportunities for school functioning and improving students' academic success (Davis et al., 2005). Recently, there has been a growing interest in enhancing professionalism, skills, and competencies of school principals (e.g., Admiraal et al., 2016; Gaikhorst et al., 2019; Hallinger et al., 2013; OECD, 2013; Radinger, 2014).

The studies presented in the international literature above are based on a strong theoretical foundation. Therefore, they provide a guiding framework to establish advanced standards for countries. However, at the national level, the needs of schools vary in terms of their interaction with each nation's own cultural structures and educational systems. Therefore, studies conducted in Turkiye regarding the professional development needs of school principals have also been carefully examined (e.g., Aktepe, 2014; Gumuseli, 2002; Gurkan & Toprakci, 2018). In these studies, which were designed in qualitative research design, it was determined that school principals needed in-service training in subjects such as educational technologies and curriculum development. However, the limitation of these studies is that they only captured the perspectives of school principals, neglecting international standards. Furthermore, the qualitative nature of these studies indicates a gap in terms of quantitative designs for identifying the professional development needs of school principals. Thus, this study aimed to develop a scale in international professional standards to measure the professional development needs of school principals in Turkiye.

METHOD

RESEARCH DESIGN

The survey research was designed in this study. The following steps were followed in the process of developing the Professional Development Needs of School Principals Scale (PDNSP): (I) Producing

the pilot survey, (II) Conducting the pilot survey, (III) The analysis of pilot results and revision, (IV) Conducting the revised survey and (V) The analysis of the results.

PARTICIPANTS

The study was conducted on a population comprising all principals working in public primary and secondary schools. The pilot study sample was purposefully selected from this population and consisted of principals who voluntarily attended an in-service training program designed for them at the beginning of the 2018-2019 academic year. This sample can be considered an example of purposive sampling, which is a non-random sampling procedure where researchers use their judgment to select a sample that aligns with their research objectives. The justification for this sampling method is that researchers who are familiar with the population can select participants that are most suitable for their research goals (Campbell et al., 2020).

The survey was administered using a paper-and-pencil method to the principals who applied to the in-service training program, and the sample can be considered motivated and interested in professional development. Prior to administering the survey, informed consent forms were presented to the participants, outlining the purpose, benefits, and risks of the study, and they were informed that their identities would remain anonymous. However, after a preliminary analysis, participants who selected the same answer for the entire scale were eliminated from the data pool, and scales with more than 5% of items left blank were also excluded from the analysis.

Therefore, to reach the target group with the highest self-awareness about their professional development, the pilot data were gathered from this group of 652 school principals intentionally. 648 surveys were returned with usable data for a response rate of 99.4%. The mean age of participants was 42 (range 25-62 years), with 36.7% holding a graduate degree and 11.4% having more than 20 years of experience in school administration. About one-third of them work at the primary school level (33.6%, *n*=218).

The data for the main study were gathered from 655 school principals at the end of the 2018-2019 academic year. Ultimately, 645 surveys were returned with a response rate of 98.5%. The mean of the participants' age was 47 (range 25-65 years), with 30.5% holding a graduate degree and 21.2% having more than 20 years of experience in school administration. About one-third of them work at the primary school level (33.2%, *n*=214).

DEVELOPMENT OF THE SCALE

The data was collected with the PDNSP that was developed by using Hinkin's (1995) guidelines for item generation and scale development: (1) Item generation, (2) Scale development, and (3) Scale evaluation. In the first phase, basic themes were identified, and an initial item pool was constructed, drawing from previous research and other related documents (MoNE in-service training course catalogs, several international standards for school principals, and teacher education programs). In particular, The Australian Professional Standard for Principals [APSP] (2014) references are considered in terms of school principals' general professional standards. The standards describe three leadership requirements common to all leaders: (1) Vision and values, (2) Knowledge and understanding, (3) Personal qualities, and social and interpersonal skills. Furthermore, Pont et al. (2008) suggestion of the core responsibilities of school leadership, namely: (1) Developing and evaluating teacher quality (2) Goal-setting, assessment, and accountability (3) Strategic resource management (4) Leadership beyond the school borders were also taken into account. The items like "developing a vision definition for the school" and "supporting collaboration among school stakeholders" were generated from the APSP perspective.

In addition to APSP, Professional Standards for Educational Leaders (PSEL) (2015) proposed by the National Policy Board for Educational Administration was also reflected in the item pool. PSEL proposes 10 standards for school leaders: (1) Mission, vision, and values, (2) Ethics and professional

norms, (3) Equity and cultural responsiveness, (4) Curriculum, instruction, and assessment, (5) Community of care and support for students, (6) Professional capacity of school staff, (7) Professional community for teachers and staff, (8) Meaningful participation of families and community, (9) Operations and management, (10) Improvement of the school. The items in the scale, such as "supporting teachers' professional development" and "being accessible to parents" were generated from the PSEL perspective.

Hallinger et al. (2013) reviewed a critical approach with the Principal Instructional Management Rating Scale (PIMRS). The scale is grounded in a conceptual framework proposing three dimensions in the instructional leadership role: (1) Defining the school mission, (2) Managing the instructional program, and (3) Developing a positive school learning climate. Some items (e.g., developing a mission statement for the school and creating an equitable and just school climate) were generated from this scale. Moreover, the policy framework in the French Community of Belgium defines three critical areas of competence for educational leaders: (1) Pedagogical leadership, (2) Interpersonal skills, and (3) Resource management. In France, school leaders are assessed on their performance in four competency areas: (1) General leadership (e.g., vision, core values, and ideals), (2) Pedagogical leadership (e.g., leadership for teaching and learning), (3) Community relationships (e.g., working with families, communities, and external partners) and (4) Resource management (e.g., administration of buildings, facilities, financial, human resources, and time resources of staff) (OECD, 2013). These dimensions were examined critically and reflected in the item pool generation process under three factors. For instance, the items like "developing a program planning, implementation, and evaluation system in line with the needs and interests of students" and "establishing an effective accounting system" were generated from these approaches.

In the second phase, the researchers integrated each conceptual dimension to make them more broadly applicable to school principals' professional development needs. In order to ensure the face and content validity of the instrument, the researchers requested expert opinions from six academics from the departments of Curriculum and Instruction, Educational Leadership and Administration, and Educational Evaluation and Measurement. Acting in line with expert opinions, the researchers reduced the scale from 57 items to 51 items. The scale was designed as a 5-point scale ranging from "Very little" to "Strong need." The scale was revised after the pilot study. The final version consisted of 39 items with three factors. These factors were labeled as *Leadership Capacity, Financial Management,* and *Vision and Values.*

In the third phase, exploratory and confirmatory analyses were conducted by using the data collected from the principal and vice principals as explained below. Additionally, we correlated factors to examine discriminant validity.

DATA ANALYSIS

The factor analysis was performed with data from the pilot and main PDNSP studies. In the pilot study, EFA was performed, and Cronbach Alpha values were calculated with the data gathered from 648 school principals. However, in the main study, which conducted factor analysis, the data gathered from 645 school principals was split into two random subsamples (n_1=323, n_2=322). The split-sample method is a cross-validation procedure for the raw data for exploration and confirmation in two random subsamples (Jöreskog & Sörbom, 2006; Thompson, 2004). EFA was conducted on n_1 subsample and CFA was conducted on n_2 subsample to ensure cross-validation. Descriptive statistics, EFA, and reliability analysis were conducted using SPSS 18, and the CFA was performed using LISREL 8.80 for Windows.

Before the analysis, the researchers tested the assumptions of the EFA. The correlations were above .30, Bartlett's Test of Sphericity was significant (p<.05), and KMO (Kaiser-Mayer-Olkin) value was greater than .60 (KMO=.98) (Field, 2005; Tabachnick & Fidell, 2007). Univariate normality was tested by skewness and kurtosis values, the significance of the Kolmogorov-Smirnov test, and histograms with

normal curves. Kline (2011) considered values greater than 3 and 10, respectively, as cut-off points for determining univariate normality, especially for the skewness and kurtosis index. Since univariate normality is not a prerequisite for multivariate normality, Mardia's (1985) multivariate kurtosis coefficient was also examined in this study: for the normality assumption to be acceptable, the critical ratio for the coefficient must not exceed 1.96. Boxplots were also examined to determine univariate outliers, and it was found that there were no serious outliers in the data. Considering all the following criteria $N/p>5$, $N/p>6$, $N/p>10$, or $N>250$, the sample size of this study was acceptable (Cattel, 1978; Comrey & Lee, 1992; Everitt, 2001; Gorsuch, 1983). Tabachnick and Fidell (2007) state that in cases where scale factors are related ($r\geq.32$), the oblique axis rotation approach can be preferred in rotation operations. In this study, the direct oblimin rotation technique was used because of the high level of relationships between sub-dimensions. The criterion for determining the factor number was a minimum Eigenvalue of 1.00. According to the advice of Field (2005, p. 692), the factor loadings less than .30 were suppressed.

The factor structure obtained with EFA was tested with confirmatory factor analysis (CFA). The criteria for assessing the conformity of the scale, the χ^2 value was calculated (Finney & DiStefano, 2013). The other goodness of fit indices were used by considering the following criteria; RMSEA is less than or equal to .06, SRMR is less than or equal to .08 (Hu & Bentler, 1999), GFI is greater than .90 (Marsh & Hau, 1996), CFI is greater than .95 (Browne & Cudeck, 1993), and IFI is greater than .90 (Byrne, 1998). Cronbach's alpha internal reliability coefficient and item-total correlations were used to determine the reliability of the whole scale and its sub-dimensions.

RESULTS

PILOT STUDY

To determine the factor structure of the scale, an EFA was performed. Before the analysis, the researchers tested the assumptions of the EFA: There was no correlation coefficient less than .30. The Bartlett test resulted in a significant value ($p<.05$), and the KMO value exceeded the criterion value of .60. The skewness and kurtosis values, which are indicative of a normal distribution, were between -3 and +3. Since the Kolmogorov-Smirnov Test was found as significant ($p<.05$), the histograms of the univariate normality were checked, and it was noticed that the univariate normality was not violated according to the histogram with normal curves. Cases that had Mahalonobis Distance values greater than the critical value were checked to detect multivariate outliers. The results were deemed appropriate to proceed with the factor analysis.

EFA showed that the scale factors were grouped into three dimensions. However, items 6, 15, 16, 18, 19, 20, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 43, 44, and 46 of which factor loading values were less than .10, were removed from the scale (e.g., Being informed about the legislation rules/Feeling responsible for students' academic success/Stimulating teachers and students in line with the school goals/Following and implementing new approaches to learning and teaching/Supporting creative and innovative employees/Having critical thinking skills/Developing a program planning, implementation, and evaluation system in line with the needs and interests of students/Including stakeholders in the decision-making process/Solving the problems encountered in the teaching-learning process/Promoting the effective use of technology in teaching and learning/Improving the physical conditions of the school/Delegating authority to teachers and staff in meeting students' needs/Developing a corporate belonging/Supporting collaboration among school stakeholders/Creating a learning culture and climate at school/Creating an atmosphere of trust in the school/Planning the staff workload/Evaluating the development of teachers and staff based on data and research/Cooperation with parents and community/Effective communication with central administration/Social media management). Another EFA was applied to the remaining 30 items, and the analysis results revealed a three-factor structure that explained 79.62% of the variance: *Vision and*

Values, *Leadership Capacity*, and *Financial Management*. Following the pilot study, a scale with 30 items was developed. Cronbach's alpha values of the sub-dimensions were .95, .99, and .94, respectively. It was .99 for the total scale. The item-total correlations varied between .62 and .90. The main study started considering the pilot study's EFA findings and reliability values.

EFA RESULTS OF THE MAIN STUDY

Before the analysis, EFA assumptions were tested using the split-sample method (n_1=323) in the main study. In checking the EFA assumptions, similar results were obtained with the pilot study, and the three-factor structure of the scale was tested. According to the EFA results regarding the main application, the scale had three factors and the three-factor structure explained 85.31% of the variance. The factor loadings, mean, and standard deviation values of the scale were given in Table 1.

Table 1. *Factor Loads, Means and Standard Deviation Values for PDNSP*

Items	*Leadership Capacity*	*Financial Management*	*Vision and Values*	*Mean*	*SD*
13. Having an equal and fair understanding of employees	.86			3.52	1.64
14. Being objective in his/her appraisals	.84			3.49	1.60
10. Creating an equitable and just school climate	.84			3.60	1.57
11. Having a value system regarding democracy and human rights	.83			3.56	1.54
45. Cooperating with teachers	.81			3.61	1.53
41. Communicating with teachers effectively	.80			3.65	1.47
8. Making decisions in accordance with the norms and ethical rules of the profession	.80			3.60	1.50
42. Being accessible to parents	.79			3.54	1.51
37. Getting to know the school neighborhood	.77			3.53	1.49
5. Adopting professional ethical values and acting in accordance with them	.76			3.61	1.50
40. Communicating with students effectively	.75			3.62	1.45
7. Being aware of his/her power and responsibilities	.75			3.69	1.48
9. Encouraging employees to work within the framework of ethical rules	.74			3.65	1.41
38. Introducing the school to its neighborhood	.73			3.57	1.41
21. Evaluating problems from a systematic and holistic perspective	.70			3.67	1.32
33. Supporting teachers' professional development	.69			3.79	1.36
39. Being a good speaker and listener	.67			3.72	1.32
12. Producing appropriate policies without prejudice against marginalized students	.67			3.64	1.28
36. Providing feedback to teachers and staff as a result of evaluations	.65			3.66	1.29
17. Being a source of inspiration in all matters of school	.61			3.66	1.27
24. Using assessment and evaluation data appropriately in decision-making processes	.60			3.66	1.27
50. Establishing an effective accounting system		.87		3.67	1.27
51. Budgeting		.78		3.71	1.30
49. Cooperating with the public and private sector		.76		3.70	1.28
48. Making an effort to create resources for the school within legal limits		.70		3.77	1.31
47. Knowing the legislation related to the management of financial resources		.68		3.71	1.33
1. Developing a vision definition for the school			.86	3.56	1.20
2. Developing a mission statement for the school			.86	3.59	1.22
4. Determining strategies to improve the values, norms, and myths of the school			.76	3.67	1.17
3. Developing the basic values of the school			.74	3.66	1.24
Mean	3.62	3.71	3.62		
Standard deviation (SD)	1.32	1.19	1.15		
Explained variance (%)	44.66	21.23	19.42		

CFA RESULTS OF THE MAIN STUDY

Factor structures based on EFA results were tested on the second sample (n_2=322) with a robust maximum likelihood estimation by CFA, and the results proved that the three-factor structure showed good fit indices (Table 2). The $\chi 2$ statistic value is the classical goodness of fit and tests whether the original variable matrix differs from the assumed matrix. Because the $\chi 2$ statistic is sensitive to sample size (Jöreskog & Sörbom, 2006). There is no consensus regarding an acceptable ratio for this test, but recommendations range from as high as 5.0 (Wheaton et al., 1977) to as low as 2.0 (Tabachnick & Fidell, 2007). $\chi 2/SD$, RMSEA, CFI, and IFI values were in acceptable ranges. The standardized loadings of the three-factor structure of the PDNSP were .95 for *Leadership Capacity*, .93 for *Financial Management*, and .81 for *Vision and Values* (Figure 1).

Table 2. *Comparison of the Goodness of Fit Index Values of PDNSP*

PDNSP: Model Description	χ^2	*SD*	(χ^2/SD)	*RMSEA*	*SRMR*	*GFI*	*CFI*	*IFI*
Three-factor model	1660.50	402	4.13*	.10	.07	.59	.99	.99

*p<.001

Note. SD: Standard deviation, RMSEA: Root mean square error of approximation, SRMR: Standardized root mean square residual, GFI: Goodness of fit index, CFI: Comparative fit index, IFI: Incremental fit index.

The relationship between sub-dimensions and school principals' professional development needs was examined (see Table 3). The five-point scale was interpreted so that a response of 5.00-4.21: "strong need," 4.20-3.41: "regular need," 3.40-2.61: "occasional need," 2.60-1.81: "rare need," and 1.80-1.00: "very little" in accordance with Tekin's (1996) classification. It was found that school principals' professional development needs were "occasional need" (*M*=3.54, *SD*=1.24). In detail, the highest need was in the *Financial Management* sub-dimension (*M*=3.62, *SD*=1.22), and it was followed by *Leadership Capacity* (*M*=3.60, *SD*=1.22) and *Vision and Values* sub-dimensions (*M*=3.54, *SD*= 1.10). The items with the highest means were "Making an effort to create resources for the school within legal limits" in the *Financial Management* sub-dimension (*M*=3.77, *SD*=1.31), "Supporting teachers' professional development" in the *Leadership Capacity* sub-dimension (*M*=3.79, *SD*=1.36), and "Determining strategies to improve the values, norms, and myths of the school" in the *Vision and Values* sub-dimension (*M*=3.67, *SD*=1.17), subsequently.

The Cronbach's alpha values (Cronbach, 1951) of the sub-dimensions ranged from .95 to .99, and it was measured .99 for the total scale. According to the Pearson correlation analysis, there was a positive and significant relationship between *Vision and Values*, and *Leadership Capacity* (*r*=.81, *p*<.01), and *Financial Management* (*r*=.79, *p*<.01). A similar correlation was observed between *Leadership Capacity* and *Financial Management* (*r*=.89, *p*<.01). Item-total correlation values ranged between .84 and .95. The results yielded that all dimensions had a high degree of reliability.

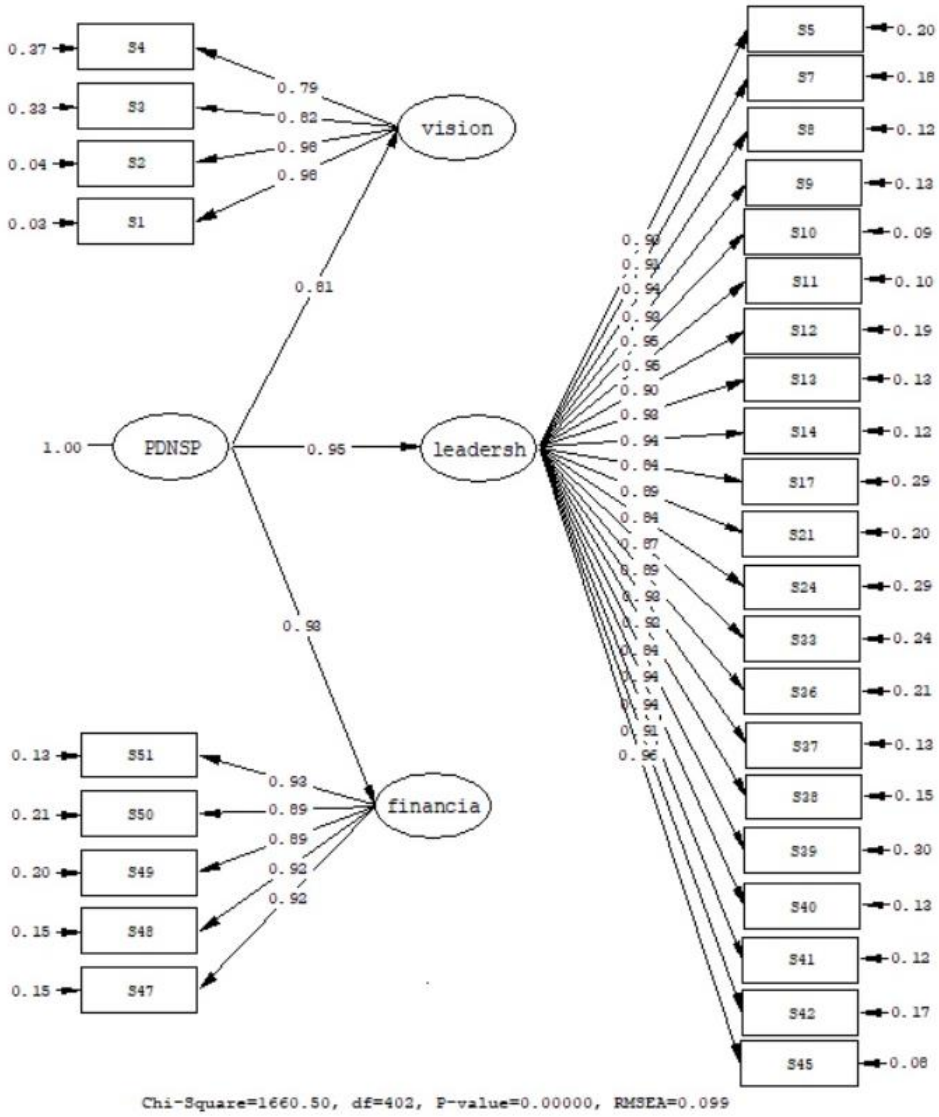
Table 3. *PDNSP's Sub-Dimension Statistics*

	CR	AVE	MSV	*Mean*	*SD*	CA	Vision and Values	Leadership Capacity	Financial Management
Vision and Values	.881	.659	.656	3.54	1.10	.95	**.82**		
Leadership Capacity	.950	.871	.792	3.60	1.22	.99	.81**	**.93**	
Financial Management	.872	.813	.792	3.62	1.22	.96	.79**	.89**	**.90**
Overall				3.54	1.24	.99			

** Correlation is significant at the .01 level.

Note. CR: Composite reliability, AVE: Average variance extracted, MSV: Maximum shared variance, SD: Standard deviation, CA: Cronbach's alpha.

Figure 1. *The Standardized Loadings of the Three-Factor Structure of the PDNSP*



DISCUSSION AND CONCLUSION

This study aimed to develop and validate a self-report scale on the professional development needs of school principals in Turkiye. In the scale development process, the guidelines of item generation, scale development, and evaluation proposed by Hinkin (1995) were followed. Firstly, the item pool was created considering national documents, as well as policy documents from countries such as the United States and Australia, which were examined, and based on this, an international professional development scale for school principals was designed. Going beyond the instruments developed by Aktepe (2014), Gumuseli (2002), and Gurkan and Toprakci (2018), this instrument takes a broader perspective by focusing not only on the qualitative research design studies but instead looking for aspects of a more quantitative design in order to also include the international professional development needs and competencies for school principals.

The item pool had 51 items in the pilot study. These items are the common professional development needs obtained from the documents defining the competence areas of school principals, such as OECD (2013), APSP (2014), and PSEL (2015). The EFA was used to reveal the factors and test content validity. This technique estimates the factors and structures that cannot be measured directly (Beavers et al., 2013). The results showed that twenty-one items provided an unexpected loading and

cross-loading model, after which these items were removed from the scale. The 30 items and three-factor structure were obtained.

The main study showed that the scale was a three-factor structure according to the EFA results obtained using the split-sample method. CFA was applied to the split-half samples and it was determined that the three-factor structure had good fit index values and reliable results. In conclusion, the *PDNSP* was finalized as a 30-item instrument, with sub-dimensions for vision and values (4 items), leadership capacity (21 items), and financial management (5 items).

The study results revealed that school principals in Turkiye need professional development in specific areas such as *financial management*, *leadership capacity*, and *vision and values*. Those needs comply with international standards and competencies in educational leadership (e.g., APSP, 2014; OECD, 2013; PSEL, 2015). *Financial management* is inevitable for schools; nevertheless, there are concerns regarding school leaders' ability to fulfill this responsibility effectively (OECD, 2017). In this sub-dimension, school principals' highest professional development need is "Making an effort to create resources for the school within legal limits." The literature reported that school leaders' capacity to create school resources might be limited due to a lack of training and interest (Ng & Szeto, 2016). The research findings with American and Chinese school principals revealed low self-efficacy problems in creating financial resources and needed professional development (Shoho & Barnett, 2010; Wong, 2004). Effective school leaders are accountable, ethical, and responsible stewards of the school's financial resources. They undertake effective financial planning and management practices to ensure the appropriate utilization of resources (PSEL, 2015). In doing so, they are expected to remain within legal limits and abide by the principle of transparency (Talikan, 2021). Financial management skill, which involves creating alternative financial resources, is challenging to acquire and needs to be supported by professional development opportunities (Lusardi, 2019). Financial resources need to be allocated effectively to maintain the school's day-to-day operations and assess the impact on student outcomes and value for money (PSEL, 2015).

School leaders need effective professional development practices to adopt *leadership capacity* which supports school improvement (Salazar, 2007). In this sub-dimension, school principals' emphasized that their highest professional development need is "Supporting teachers' professional development." This finding is consistent with Gaikhorst et al. (2019) and Meister (2010). Effective school principals can lead improvement and do so by providing teachers with professional development opportunities, encouraging them, visiting classrooms frequently, and providing detailed feedback on teaching practices, helping to increase teaching and teacher self-efficacy (Lambert, 2005; Leithwood et al., 2006; Radinger, 2014). In this respect, when the school principal gains the ability to support teachers in their professional development, they will be able to create a capacity by leading the desired changes, as well as exhibiting instructional leadership behaviors at school, and create a high standard capacity for the learning organization (Hooper & Bernhardt, 2016).

Finally, *vision and values* was found as another factor in the study. In this sub-dimension, school principals' highest professional development need is "Determining strategies to improve the values, norms, and myths of the school." School principals need to identify and implement strategies to collaborate with school and community members, use relevant data, and what practices to represent that promote the successful learning and development of each child to identify values, norms, and myths (PSEL, 2015). These strategies and adoption ensure that the school vision is clarified and adopted, which plays a critical role in school performance (Hallinger & Heck, 2002; Pont et al., 2008). Thus, school leaders' efforts to create vision and values increase their colleagues' motivation (Leithwood et al., 2006). Successful school leaders adopt personal, moral, and educational values and express them faithfully (Gold et al., 2003). It is about creating favorable conditions by applying many different things. The restructuring of the school in different ways rather than standard procedures may lead to anxiety. Thus, school principals may need professional development in creating vision and values (Dempster, 2001).

EDUCATIONAL AND PEDAGOGICAL IMPLICATIONS

School effectiveness is a complex and multifaceted concept, encompassing various factors that influence school outcomes, such as student achievement (Heck & Hallinger, 2010; Leithwood & Jantzi, 1999). Although the role and importance of school principals in enhancing school outcomes are widely recognized, their impact on students is also mediated through teachers and school climate (e.g., Hallinger, 2003; Murphy et al., 2016). School principals can indirectly affect student performance by intervening in teachers' pedagogical strategies (Heck & Hallinger, 2014) or by fostering a positive learning environment through improving school culture (May & Supovitz, 2011).

The findings of this study have important implications for the professional development of school principals in Turkiye, especially in the areas of financial management, leadership skills, and vision and values. Developing financial management skills among school principals can lead to more efficient utilization of school resources, resulting in a better physical learning environment. Addressing the leadership capacity skill needs can support teachers' professional development and encourage positive teaching environments through instructional leadership behaviors (Hallinger, 2003). By fulfilling the vision and values-related skill needs of school principals, stronger school culture and effectiveness can be created, promoting a conducive learning environment and enhancing student outcomes (Turkmenoglu & Bulbul, 2015).

LIMITATIONS AND FUTURE RECOMMENDATIONS

The exploratory, confirmatory factor analysis and the reliability analysis indicated that the PDNSP could be a useful instrument in researching principals' professional development needs. It is still thought that the instrument may contribute to the studies designed to develop professional development programs or in-service training content for school principals. Thus, further validation of the PDNSP is necessary for different contexts. As Leithwood et al. (2004) proposed that administrative skills vary according to the school types, and cultural and economic features, it should be considered that school principals' needs and preferences may differ in different school types and class levels. Besides, the data were collected only from school principals working at public schools. The items should be reviewed considering the private school conditions while investigating school principals' professional development needs at private schools. Such kind of scales can not be used as a single measure of the needs. As Guskey (1997) argued, the needs data should be triangulated by quantitative and qualitative analysis of multiple cases to develop a promising program that would yield valuable insights with practical significance.

AUTHOR CONTRIBUTIONS

Both authors have made substantial contributions to the conceptual framework, acquisition of data, discussion, conclusion, and implications. Specifically, the first author has made contributions to the conception, design, analysis, and interpretation of data. The second author has been involved in drafting the manuscript and revising it critically for important intellectual content.

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Some Demographic Variables, Hope and Perceived Social Support as Predictors of Career Decision Making Self-Efficacy to College Students

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Abstract

College years in people's lives are a significant transition period in career-related decisions. One personal factor that impacts career-related decisions is an individual's career decision-making self-efficacy. On the other hand, today's complexity in the world of work, such as high employment rates, changes in the nature of work with technological developments, and increased uncertainties in modern life, make the career decision-making process more complex than ever. Drawing from the social cognitive career theory, this study investigated the role of cognitive-person (gender and hope) and contextual (socio-economic status and perceived social support) variables in predicting career decision-making self-efficacy among the 781 college students in Turkey. Hierarchical regression analyses showed that hope and perceived social support explained 38.5 % of the variation in career decision-making self-efficacy, among which hope was the strongest predictor. On the other hand, gender and socio-economic status are not robustly linked to career decision-making self-efficacy. Theoretical and practical implications for college-level career counseling and student support services are discussed.

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INTRODUCTION

College years are a crucial period for students when it comes to career-related decisions. Turkey has the highest youth population compared to other European countries, and, as of 2021, 1.112.747 students graduated from higher education institutions in Turkey (Higher Education Institute, 2021). For these young people, career decision-making process can be challenging because of negative factors such as economic inequality, high unemployment rates, and minimal resources for having access to career counseling (Kaya-Erdoğan, 2021). The recent academic literature on Turkish studies in career counseling at the college level has increased, however, there is still a need in the literature for studies examining the career decision-making processes of youth in Turkey. As these studies increase, it will be possible to understand college students' career decision-making processes better. This will also help develop evidence-based interventions that are especially important given that college years are critical in preparing students for the school-to-work transition. Based on this idea, we examined the role of personal and contextual factors, namely gender and socio-economic status, hope, and perceived social support, in predicting career decision-making self-efficacy in the social cognitive career theory framework.

CAREER DECISION MAKING SELF-EFFICACY (CDMSE) WITHIN SOCIAL COGNITIVE CAREER THEORY

One personal factor that impacts career-related decisions is an individual's career decision-making self-efficacy (CDMSE). First coined by Bandura (1977), self-efficacy is individuals' beliefs in their competencies to complete successfully the desired work. Hackett and Betz (1981) were the pioneering scholars who first used the concept "self-efficacy" in career counseling. One of the most important variables explaining why people with similar capacities achieve very different results regarding career performance, especially in challenging situations, is self-efficacy (Lent, Brown & Hackett, 2002). Lent, Brown, and Hackett (1994) proposed the Social Cognitive Professional Theory in the field of career development (SCCT), and within this theoretical framework, they defined CDMSE as the degree of a person’s belief that he/she can accomplish the tasks necessary to make career decisions (Taylor & Betz, 1983).

In the SCCT framework, an array of cognitive-person variables (e.g., gender, genetic, race-ethnicity, physical health, and disability) and contextual variables (e.g., socio-economic conditions, cultural norms, perceived support from others) interact with each other. These factors and their interaction influence individuals’ CDMSE which ultimately affects their career-related performance outcomes. The independent variables of the current study, namely socio-demographic factors (gender and socio-economics status), hope, and perceived social support, can be considered personal and contextual factors connected to CDMSE from the SCCT perspective.

Empirical research on the consequences and correlates of CDMSE indicates that it is a critical component of positive career-related outcomes. For example, a high level of CDMSE is associated with a low level of career indecision (Büyükgöze Kavas, 2011; Duru et al., 2021), resulting in greater involvement in career exploration activities (Chen, et al., 2021) and better career adaptability (Rahim et al., 2021). Briefly, CDMSE is a deciding factor for successful career decision-making. Besides, today's complexities in the world of work, such as high unemployment rates, changes in the nature of work via technological developments, and increasing uncertainties in modern life, make the career decision-making process more complex than ever (Xu, 2021). All these findings encourage college career counselors to understand the concept of CDMSE better and develop intervention strategies to increase students' CDMSE. Therefore, determining the factors related to CDMSE might help offer appropriate interventions (Duru, 2021).

DEMOGRAPHIC VARIABLES

The SCCT framework suggests that individuals' demographic background, such as gender and socio-economic status (SES), form their career decision-making process. As reported by SCCT, the level of access to the primary sources of efficacy information is impacted by different gender role socialization (Lent and Hackett, 1987). For example, women may be more encouraged to work in career fields dominated by women than men and vice versa. The lack of role models for women and men in certain relative occupations is also an important factor in the formation of career self-efficacy. Traditionally, women's socialization within the home and men's socialization outside the home differentiate their perceived skill sets, which ultimately affects individuals' perceptions of career skills. Similarly, family SES impacts people's access to enriching learning experience opportunities that are the sources of self-efficacy. Therefore, the presence or absence of family economic resources becomes an influential factor in individuals' career development (Lent et al., 1994).

Literature investigating the relationship between gender and CDMSE shows contradictory findings. Some empirical studies in the literature have revealed that gender is a significant factor in determining career self-efficacy (Kılıç, 2018; Lam & Santos, 2018). However, some studies do not support the association between gender and CDMSE (Chung, 2002; Nauta and & Kahn, 2007; Ulaş, 2016; Duru, 2022). The same contradictory findings also apply to SES. The studies in the related literature supports that university students with higher SES have higher levels of CDMSE, whereas lower SES indicates lower levels of CDMSE (Hsieh & Huang, 2012; Bozgeyikli et al., 2009). Other studies concluded that there is no significant association between SES and CDMSE (Ali et al., 2005; Metheny & McWhirter, 2013; Shin & Lee, 2018).

It is considerable to understand demographic factors that facilitate or hinder college students' CDMSE to address the needs of a particular gender or SES group and tailor counseling interventions to foster their career self-efficacy. Lent et al., (2018) warn that making uniform assumptions about the associations between socially constructed demographic variables and the career decision process can be misleading because certain groups may not necessarily share certain experiences as opposed to conventional thinking. Thus, more empirical research is needed to examine how these variables affect the occupational development trajectory of college students (Lent et al., 2018).

HOPE

Hope is a set of learned beliefs and thinking patterns that connect the individual to positive outcomes or goals (Synder, 2000). Hope plays a substantial role in an individual realizing new strategies and resources when all the practical ways to reach the goal have been exhausted (Snyder et al., 2002). According to Snyder (2002), hope involves two goal-directed cognitive components: agentic thinking and pathways thinking. Agentic thinking refers to motivational energy to achieve a goal. Individuals high in agency tend to stick to plans that pave the way to desired destinations. Agency is considered a willpower component of hope.

In comparison, pathways thinking refers to the capability of coming up with alternate plans if an initial path cannot be followed. Especially during challenging times, a strong sense of pathways thinking helps individuals think of multiple routes to the desired outcome. Pathways thinking and agentic thinking have reciprocal relationships, and hope is in place when both ways of thinking exist (Snyder et al., 2005). Snyder's conceptualization of hope and Bandura's conceptualization of self-efficacy show some commonalities yet they are unique constructs of their own (Magaletta & Oliver, 1999). While both self-efficacy and hope are cognitive constructs and beliefs about competencies to meet goals, hope is also related to coming up with effective strategies in creating paths that lead to desired outcomes without losing willpower even under challenging conditions. In addition to that, self-efficacy is a domain-specific term, not a global trait. Therefore, what domain it is linked to, such as mathematics self-efficacy and CDMSE, has to be identified (Betz and Hackett, 2006). At the same time,

hope is more of a general personal trait and can be applied across situations and domains. Accordingly, in the current study, we address hope as a personal trait that can be considered a personal input in the SCCT framework in predicting CDMSE.

The existing literature suggests a connection between hope and CDMSE. For example, researchers examined acculturation and dispositional hope as predictors of CDMSE with 213 Korean undergraduates in United States. (In, 2016). The findings revealed that dispositional hope positively predicts CDMSE above and beyond acculturation. Similarly, Sarı and Şahin (2013) accounted for the positive predictive link between hope and CDMSE in 302 senior high school students in Turkey. Furthermore, Sung, Turner and Kaewchinda (2011) found a reciprocal relationship between career development outcomes such as self-efficacy and the agency component of hope. They concluded that the agency component of hope predicts and is predicted by career development outcomes.

In summary, the literature review indicates that keeping motivation high even under challenging conditions and producing alternative ways even when the paths to the goal are blocked. In other words, high levels of hope determine the beliefs of students that they can succeed in their career decision making process. In the current research, we used a measurement tool based on Synder's conceptualization of hope as it emphasizes that hope can be fostered and instilled, which is particularly important in college career counseling. After all, such conceptualization allows career counselors to develop and implement interventions to increase hope.

PERCEIVED SOCIAL SUPPORT

In the SCCT, as well as cognitive-person variables such as hope, contextual variables such as perceived social support also influence the CDMSE (Lent et al., 2000). Social support refers to how much support an individual receives from the people around her/his in terms of being cared for, helped, and responded to (Cobb, 1976; House, 1981). Perceived social support refers to individuals' beliefs and interpretations about the level and quality of support provided by the people around them (House, 1981). An individual's perception of the social support they have is much more important for well-being than how much social support they actually receive (Cohen et al., 2003). The SCCT framework also proposes that the power of a contextual variable such as social support on career-related outcomes depends on individuals' interpretations of this variable (Garcia, et al., 2012). How individuals perceive the support they received affects both, directly and indirectly, their skills and cognition.

Compared to individuals who receive low social support, the ones who receive higher social support are more optimistic, have more positive self-efficacy perceptions, are more successful in managing stress. In addition to that they can more effectively cope with difficulties, including career difficulties—perceived social support is highly connected with career-related variables. Empirical evidence indicates a strong correlation between social support and career adaptability (Hlad'o et al., 2019; Öztemel & Yıldız-Akyol, 2021), career aspirations, career search self-efficacy (Nota et al., 2007), career maturity, and perceived career barriers.

As consistent with the SCCT, the literature also points to perceived social support as a significant independent variable accounting for the variance in explaining CDMSE. For example, Garcia et al. (2015) modeled CDMSE as a mediator between social support and career optimism. They concluded that social support fosters CDMSE, then CDMSE influences college students' optimism. Quimby and O'Brien (2004) found strong evidence for a positive association between social support and CDMSE for nontraditional college women with and without children. In addition, both Mert et al. (2019) and Gushue and Whitson (2006) reported that social support is a significant predictor of CDMSE in their study of secondary school students. Likewise, in their meta-analysis study, Choi et al. (2012) observed a strong correlation between the two concepts. Patel, et al. (2008), in their study on 85 Vietnamese adolescents in the Washington, D.C. area, observed peer support accounted for unique variance in the

prediction of CDMSE as opposed to family and school social support which reportedly did not contribute to the understanding of CDMSE in their sample. This finding suggests that immigrant students perceive their peers as more knowledgeable about the world of work in America and the education system than their families. Garcia et al. (2012) conducted hierarchical regression in their study of 141 college students, and their results revealed that a high level of perceived parental support was associated with CDMSE.

Based on SCCT and previous research, it can be concluded that having some support from parents, peers, or significant others provides significant resources and confidence to individuals necessary to enable CDMSE both directly or indirectly.

THE CURRENT STUDY

SCCT emphasizes the significance of cognitive-person variables such as hope in career development. The theory also highlights the role of contextual variables, such as perceived social support, in shaping cognitive factors and, consequently, developing career self-efficacy (Lent et al., 2000). Besides SCCT, the existing literature also suggests a connection between hope, PSS, and CDMSE. One could argue that cognitive variables such as hope and contextual variables such as social support can alleviate and buffer the effects of negativities in many areas of life so that sufficient hope and social support could play a positive role in students' CDMSE levels. Accordingly, the objective of the present study is to examine the influence of hope and PSS on CDMSE in a sample of college students in Turkey. Based on the theoretical and empirical considerations, it is anticipated that higher levels of hope and PSS have predictive power on CDMSE. As hope and perceived social support could be improved, developed, and taught, the findings of this study can be used to plan interventions in college career counseling to improve students' CDMSE.

Several demographic constructs also influence CDMSE. These include socio-economic status and gender. Within the SCCT, socio-economic status is considered a contextual variable, while gender is considered a cognitive-person variable. Therefore, controlling the effects of these demographic variables on understanding the relationship between hope, social support, and CDMSE is essential within the theoretical framework of this study. Accordingly, this study contributes to the existing literature by integrating four constructs related to CDMSE.

METHOD

RESEARCH DESIGN

The predictive correlational survey method was used within this study. When it is necessary to look into the connections between variables and the predictions of a criterion variable through those variables' connections to predictor variables, correlational research is utilized (Fraenkel & Wallen, 2005).

PARTICIPANTS

Participants were 781 undergraduate students from both state and private universities in Istanbul, Turkey of whom 597 (76,4%) were female, and 184 (23,6%) were male (SD=.42). Participants self-identified socioeconomic status as low (n=525, 6.6%), middle (n=579, 74.1.6%) and high (n=150, 19.2%). The sample of the research is composed of students with a range of age between 18-24. 4.4% of the participants were preparatory class students, 28.7% were first year students, 14.5% were second year students, 22.1% were third year students and 30.3% were fourth year students. These students were studying at Social Sciences (27,2%), Natural Applied Sciences (17,3%), Health Sciences (19,8%), Educational Sciences (31%), and Fine Arts (4,8%) faculties. They completed all research measures through online survey software after they granted consent. Research data was collected with the convenience sampling method. For the purposes of the study, convenience sampling entails including

people of the target population who meet certain practical requirements, such as ease of accessible, availability at a specific time, or willingness to participate (Dörnyei, 2007).

INSTRUMENTS

Participants filled out four instruments in total for this study. (1) Demographic Information Form, (2) Career Decision Making Self-Efficacy Scale – Short Form (CDMSE-SF), (3) Dispositional Hope Scale (DHS), and (4) Multidimensional Scale of Perceived Social Support (MSPSS).

DEMOGRAPHIC INFORMATION FORM

Personal Information Form was prepared by the researchers to collect demographic variables of participants. Within the scope of this research, information about gender, class, department and socio-economic status were requested from the participants.

CAREER DECISION MAKING SELF-EFFICACY SCALE – SHORT FORM

The CDSES-SF was initially created by Betz et al. (1996) to assess undergraduates' self-efficacy in performing necessary tasks during the course of their career decision-making process. There are 25 items and five subscales in order to measure aforementioned construct. Subscales are; accurate self-appraisal, gathering occupational information, goal selection, planning for the future, and problem-solving. It is a five-point Likert-type scale. The scale provides total score, and the higher the score, the higher the CDMSE. The total score one can possibly get from this scale vary between 25 and 125. Işık (2010) adapted the CDSES-SF into Turkish and reported the internal consistency as .88. The results prove that the five-factor scale with 25 items in total is compatible with the Turkish sample. Within the parameters of this study, Cronbach's internal consistency coefficient was determined to be .90 for the total scale and .74, .64, .82, .76 and .69 for the self-appraisal, gathering occupational information, goal selection, making plans for the future, and problem-solving sub-scales respectively

DISPOSITIONAL HOPE SCALE

Snyder et al. (1991) developed the Dispositional Hope Scale. There are 12 items and two subscales (pathways and agency) in this scale. It is a seven-point Likert-type scale. While there are four items for each sub-dimension in the scale, there are also four filler items. The sum of the scores of two subscales gives the total score. The total score one can possibly get from this scale vary between 8 and 64. The scale's internal consistency coefficients range from .74 to .84 throughout the entire scale. The DHS was adapted into Turkish by Tarhan and Bacanlı (2015). The researchers have obtained the same factor structure as the original scale. In the adaptation study, the internal consistency was found as .84. In the exploratory factor analysis carried on within the scope of the adaptation study, the explanatory value of the total variance calculated as 61%. The reliability of the overall scale is .76 and .75, and .82 for the agency and pathways subscales respectively in the context of the current study.

MULTIDIMENSIONAL SCALE OF PERCEIVED SOCIAL SUPPORT

Zimet et al. (1988) developed the original Multidimensional Scale of Perceived Social Support (MPSS). The scale has 12 items and three subscales (family, friends, and significant others). It is a seven-point Liker-type scale. The scale provides total score. The original form's Cronbach Alpha reliability coefficient ranges from .84 to .92. (Zimet et al., 1988). Eker and Arkar (1995) adapted the original form of the MSPSS into Turkish. The researchers have obtained the same factor structure as the original scale. The reliability coefficient of the adapted version is .89 for the total scale. The scale has an internal consistency of .88 and .72, .70, and .70 for family, friends and significant others subscales respectively in the context of this study.

DATA COLLECTION

At the beginning of the research, the required ethical and legal permissions were obtained from Yeditepe University Social Sciences and Humanities Scientific Research and Publication Ethics

Committee. Participants of the current study participated in the study voluntarily. Within the scope of this study, the participants were reached online. A consent form was obtained from the participants of the study, stating that they participated in the research voluntarily, and the participants filled out the personal information form and scales through Google Forms. This process took approximately 15 minutes for each participant. Collecting data online offers advantages in terms of both time and accessibility. In addition, the ability of online platforms to require all questions on the scales to be answered eliminates the possibility of missing data. On the other hand, the lack of face-to-face contact with the participants at the time of data collection can be seen as a disadvantage compared to other methods in that the participants may not answer the questions sincerely. After the data required for the research was collected, the data analysis process started.

DATA ANALYSIS

SPSS 26 was used to analyze the data obtained within the scope of the study. Data cleaning was done initially to make sure the data was of high quality. Using Mahalanobis distances and scatter plots, outliers were found and eliminated from the entire dataset (Tabachnick & Fidell 2007). The hierarchical regression analysis method determined whether the independent variables predicted the dependent variable. The total scale scores of the independent variables were entered into the equation in the following sequence based on the Pearson Correlation coefficients: demographic characteristics came first, then dispositional hope, and finally perceived social support.

FINDINGS

PRELIMINARY ANALYSIS

Before evaluating the measurement model, a number of preliminary analyses were carried out. First of all, regression analysis assumptions were checked so that the regression analysis results could be discussed. The distributions were accepted as normal since the skewness and kurtosis coefficients examined (highest = .69, lowest = -.79) were between -1 and +1 (Büyüköztürk et al., 2016). Durbin-Watson statistics were used to examine the autocorrelation, which is another assumption, and it was seen that there was no autocorrelation between variables (DW = 1.88 < 4). When VIF values were examined, it was found that none of the values were greater than 5 (the highest = 1.22).

CORRELATION OF CDMSE, HOPE, AND PSS

Before the hierarchical regression analysis was carried on, the correlations among the variables were examined. As shown in Table 1, CDMSE and positively correlated with dispositional hope and moderately and positively correlated with PSS ($p < .01$).

Table 1. *Pearson Correlation Coefficients Among Study Variables*

Variables	*CDMSE*	*DH*	*PSS*
CDMSE	1		
DH	.61*	1	
PSS	.38*	.43*	1

*p<.01

HIERARCHICAL REGRESSION ANALYSIS

In order to assess the predictive effects of gender, SES, dispositional hope, and PSS on undergraduates' CDMSE, hierarchical regression analysis was used. Table 2 presents the results.

Table 2. *Hierarchical Regression Analysis Results of the Predictive Roles of Gender, SES, DH, and PSS on CDMSE*

Model		*n*	*B*	*Std. E.*	*ß*	*t*	*p*
1	Constant	781	93,78	1,33		70,45	.000**
	Gender (Female)	781	-1,75	1,31	-0,05	-1,33	.183
	Socio-economic status						
	Medium SES	781	-2,94	1,43	-0,08	-2,05	.040*
	Low SES	781	-8,25	2,50	-0,13	-3,29	.001**
2	Constant	781	42,60	2,64		16,11	.000**
	Gender (Female)	781	-2,36	1,05	-0,06	-2,25	.025*
	Socio-economic status						
	Medium SES	781	-1,90	1,14	-0,05	-1,66	.096
	Low SES	781	-4,61	2,00	-0,07	-2,30	.022*
	Hope	781	1,07	0,05	0,60	21,12	.000**
3	Constant	781	37,97	2,85		13,29	.000**
	Gender (Female)	781	-1,60	1,05	-0,04	-1,51	.130
	Socio-economic status						
	Medium SES	781	-1,68	1,13	-0,04	-1,48	.137
	Low SES	781	-3,75	1,99	-0,06	-1,88	.060
	Hope	781	0,97	0,05	0,54	17,34	.000**
	Perceived Social Support	781	0,14	0,03	0,13	4,07	.000**

*p<.05, **p<.01

In the regression analysis, gender and socio-economic status were taken into the equation in the first step, dispositional hope in the second step, and perceived social support in the last step. The models tested within the scope of the research, were found to be significant (F(3,777)=4,286; p>.01; F(4,776)=116,632; p<.01; F(5,775)=98,493; p<.01). Whether the predictive role of independent variables on the dependent variable is significant or not varies based on models. While medium and low socio-economic status has a significant role in the first model, gender did not contribute significantly. In the second model, when dispositional hope was added, it showed that medium socio-economic status is not significant whereas gender, low socio-economic status, and hope are significant.

Furthermore, together, they explain the 37,2% of the change in CDMSE. In the third model, when PSS was added, gender, medium, and low socio-economic status had non-significant effect on CDMSE whereas hope and PSS had significant effect. Nevertheless, the model remained significant, and all the independent variables together explained 38,5% of the change in CDMSE. Adjusted R2 values and R2 changes between the models are presented in Table 3.

Table 3. *Comparison Values for Hierarchical Models*

Model	*R*	*R^2*	*Adjusted R^2*	*R^2 Change*	*p*
Model 1	0,128	0,016	0,012	0,016	.005*
Model 2	0,613	0,375	0,372	0,359	.000*
Model 3	0,623	0,389	0,385	0,013	.000*

*p<.05

DISCUSSION, CONCLUSION AND SUGGESTIONS

Inspired by the Social Cognitive Career Theory (SCCT), this study sought to examine potential predictors of CDMSE. Specifically, it was interested in the ability of selected demographic characteristics, hope and PSS, to predict the CDMSE of undergraduate students in Turkey. Hierarchical regression analysis was computed to analyze the predictive roles of independent variables on the criterion variable.

There were three steps of hierarchical regression analysis employed in this study. In step one, gender and SES entered the model as control variables, and data analysis showed that gender is insignificant. In contrast, SES is statistically significant in explaining variation among CDMSE scores. Namely, low and medium SES indicated lower CDMSE than high-income students. However, when hope was added to the model in the second step, gender became significant, and medium SES was no longer significantly different than high SES, while the overall model explained a 37.2 36% variation of the CDMSE scores among college students. In the final step, social support was added to the regression equation then gender and SES dummy variables became insignificant. Only hope and social support remained significant in the model, and they explained 39% of the CDMSE variation. Overall, the results showed that hope was the strongest predictor of CDMSE, followed by social support, while gender and SES were not robust variables in explaining CDMSE among college students in Turkey.

The current study's findings are consistent with other studies that found that CDMSE is accounted for by the increased level of hope and social support. The positive predictive power of hope in detection CDMSE supports previous studies by In (2016), Sarı and Şahin (2013), and Sung et al. (2011). Similarly, the positive predictive role of social support in understanding CDMSE is also in line with other studies' findings by Garcia et al. (2012; 2015), Quimby and O'Brien (2004), Mert et al. (2019), Gushue and Whitson (2006), Choie et al. (2012), and Patel et al. (2008). However, this study indicates that gender and SES are not robust variables associated with CDMSE. Based on this research finding, it can be argued that having hopeful thinking skills and supportive relationships can alleviate or help offset the negative impact of gender and economic inequality. As discussed previously, findings that focus on the relationship between gender, SES, and CDMSE yield contradictory results. As stated by Lent et al. (2018), socially constructed descriptors such as gender and SES do not always convey specific conventional experiences that make the lives of individuals in a particular group easier or more difficult in their career decision-making process. Moreover, they warned about simply focusing on gender and SES as it is not enough to promote career self-efficacy and other variables need to be considered in relation to these. This caveat of Lent et al. (2018) should be considered when interpreting the findings on gender and SES.

CONCLUSION

The current study's findings highlight the importance of hope and PSS on CDMSE among college students in Turkey. Especially the concept of hope was found to be the strongest variable in prediction of CDMSE. These findings are particularly pertinent given the complex and rapidly changing world of work, in which students are exposed to numerous stressors that could impede their career decision-making self-efficacy. Hope is the antidote of coping with difficulties. Therefore, college students can only be helped to face and endure such stressors by instilling critical hope and helping them transform their career-related worries into a constructive motivational force. Besides, higher education institutions should regularly screen the social support needs of the students to create a supportive campus community and student services. Besides, the current study's findings can be used to develop campus-based individual or group interventions about their careers that incorporate the dimension of social support and hope to help with their career development.

SUGGESTION

The findings revealed that the strongest variable in prediction of CDMSE is hope among the other variables of the present study. As supported by the findings, instilling young people's hope is an important path to increase career self-efficacy. To do so professional, campus-based career counseling services may effectively cultivate hopeful thinking. Especially career-focused group counseling programs have the potential to improve pathways thinking of hope. Group counseling provides the opportunity for group members to learn from each other. Therefore, students have the chance to observe different mental approaches in overcoming obstacles and learn about effective solutions by paying attention to other members' experiences. Counselors especially can focus on improving agentic thinking of hope by discussing the career future goals of the students. Focusing on students' past achievements and helping them discover their internal and social resources will help students determine their future goals and move steadily towards plans. Encouraging university students to do internships during their undergraduate education will also help. Through internships, students will gain experience in different employment areas of the department they are studying and will have an idea of what they will encounter when they graduate. Illuminating this road that extends into the future will enable students to see the paths leading to their goals more clearly, along with alternative paths.

Research results also implied that social support played a significant role in college students' CDMSE. Therefore, interventions to foster on-campus social support systems are important for students' career development. Colleges should be aware of the impact of social support on academic and career development, regularly collect the social support resources of students through surveys, and use this data in improving or developing student support services (Zavatkay, 2015). Peer support programs would be a way to accomplish this. Research shows that peer support services conducted on campus grounds are beneficial for students to obtain the necessary social support (Brar et al., 2012). Many types of evidence-based, on-campus peer support models exist (e.g., Suresh et al., 2021; Griffin et al., 2016; Aladağ, 2009). Colleges can adopt the appropriate one according to the resources and needs of the campus in that way colleges facilitate building effective social networks for the students which eventually help them to overcome career difficulties in their college years.

LIMITATIONS

This study has some limitations and the results should be interpreted by considering these limitations. First, although there is a relatively large number of participants in this study's scope since a convenient sampling method was used to reach them, the results are not generalizable to all college student populations in Turkey. Second, although the study findings indicate that hope and perceived social support have an important role in shaping college students' CDMSE, based on the findings of this study, a causal link cannot be inferred between the research variables since this was a cross-sectional study. Future research using more rigorous designs might help investigate the causal link between study variables to understand the exact nature of the CDMSE phenomenon better. Moreover, total PSS was examined in this study. In future studies, perceived social support from families, friends, institutions, relatives, etc., can be examined separately to understand their unique explanatory power on CDMSE. Lastly, this study was guided by the SCCT model however only a subset of the SCCT was tested. Thus, future investigations on CDMSE among college students in Turkey should examine additional cognitive and contextual factors. Despite these limitations, the current state of the literature would benefit from the findings of this study. In SCCT, understanding other variables' roles in CDMSE are important, and this study which revealed the importance of social support and hopes on CDMSE may contribute to the current literature.

AUTHOR CONTRIBUTIONS

- First author have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data.

- The second author wrote the theoretical framework, literature review, discussion, and conclusion; contributed to the checking and interpreting study findings.

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The Mediator Role of Emotional Stability in the Relationship Between the Psychological Adjustment and Cyberostracism of University Students

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Abstract

Today, one of the environments where most of the people interact with other people is virtual environments. In these environments, some individuals may be exposed to ostracism by others. This state of exclusion can also have some adverse effects on the psychological adjustment of individuals. In this context, the purpose of the current study is to investigate the mediator role of emotional stability in the relationship between university students' problems of psychological adjustment and cyberostracism. The study employed the relational survey model. The study group of the study is comprised of 320 undergraduate students in the 2021-2022 academic year. In the analysis of the collected data, Pearson Moments Correlation Coefficient analysis was conducted in SPSS-22 and the mediaton analysis was conducted. As a result of the analyses conducted within the context of the current study, it was found that the cyberostracism of the university students negatively and significantly predicted their emotional stability, while it positively and significantly predicted their psychological adjustment problems. In addition, it was determined that emotional stability played a mediator role in the relationship between university students' problems of psychological adjustment and cyberostracism. The findings of the study were discussed in relation to literature and suggestions were made.

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INTRODUCTION

The rapidly changing world order in our age can have some serious effects on the emotional and psychological adjustment of individuals. The concept of psychological adjustment, which includes the individual' process of adaptation to himself/herself and his/her environment, comes to the fore as an important factor. Rohner (2004) argues that psychological adjustment is a state closely associated with a sense of independence, positive self-esteem and self-sufficiency, stability of emotional experiences, high emotional responsiveness, reduced hostility and a positive worldview. Wolman (1989) defines psychological adjustment as an adaptive relationship with the environment and the ability of an individual to meet his/her needs and mostly his/her social and psychological needs. Poor psychological adjustment has been associated with a steadily increasing prevalence of psychopathology as well as more social and emotional problems experienced by adolescents and young adults (Freitas et al., 2013; Werner & Crick, 1999). When the studies on psychological adjustment are examined, it is seen that psychological adjustment has been found to be related to some concepts such as attachment (Lapsley & Edgerton, 2002; Matttanah, Hancock, & Brand, 2004; Seiffge-Krenke, 2006; Soncu-Buyukiscan, 2018), coping strategies (Crockett, et al. 2007; McNamara, 2000), emotional intelligence (Sulaiman, 2013), parental acceptance (Dural, & Yalcin, 2014; Kavak, 2013), witnessing parental conflicts in childhood (Diamond, & Muller, 2004) and socio-cultural adaptation (Sağaltici, 2019). Another variable thought to be related to psychological adjustment by researchers is cyberostracism. In this context, one of the variables addressed in relation to psychological adjustment in the current study is cyberostracism.

Cyberostracism can be defined as the experience of being ignored and ostracized by peers or groups on the internet (Williams, Cheung, & Choi,2000). On social networks, ostracism can also arise from ignoring someone in a conversation or in the comments section (Donate et al., 2017; Tobin, Vanman, Verreynne, & Saeri, 2015). In addition, people can also feel ostracized if a shared post doesn't get enough comments or if it is disliked (Schneider Zwillich, Bindl, Hopp, Reich, & Vorderer, 2017; Tobin, McDermott, & French, 2018; Wolf Levordashka, Ruff, Kraaijeveld, Lueckmann, & Williams, 2015). Studies have found that people's comments and likes on social media can lead to feeling of recognition and feelings of happiness, personal worth, increased self-confidence, and greater satisfaction of the need to belong (Burrow & Rainone, 2017; Reich, Schneider, & Heling, 2018). On the contrary, individuals exposed to cyberostracism may feel bad, their sense of control may be reduced, and their positive emotions may be negatively affected (Williams, et al. 2000; Williams, Shore & Grahe, 1998). Therefore, ostracism can result in some mental problems like anxiety, depression and anxiety disorders, diminishing performance and motivation, and decrease in academic and professional performance (Erdemli, & Kurum, 2021). Riva, Wirth, and Williams (2011) found that cyberostracism has a medium and positive correlation with psychological problems. Correspondingly, it is thought that cyberostracism may have a negative predictive role on the psychological adjustment of university students.

EMOTIONAL STABILITY AS A MEDIATOR VARIABLE

Emotional stability has started to be used as a concept that replaces the neuroticism dimension of positive psychology. Influenced by positive psychology, some researchers have used emotional stability as a substitute for neuroticism (Costa & McCrae, 1992; Goldberg, 1992; Mount, Barrick and Strauss, 1994). At the same time, emotional stability is a characteristic that is considered to be important by personality theorists (Cattell, 1943; Goldberg, 1981; McCrae & Costa, 1987). Emotional stability is a concept that is closely associated with the ability of remaining calm, stable, resilient, confident and self-satisfied (Costa and McCrae, 1992; McCrae and Costa, 2003). It is often conceptualized as being prone to experience negative emotional states like fear, depression, anxiety, anger, and shame (Leikas, Mäkinen, Lönnqvist, & Verkasalo, 2009). The existing research shows that while emotional stability is positively correlated with happiness (Hills & Argyle, 2001), life satisfaction

(Smith & Konik, 2021), mental well-being (Yıldırım & Atilla, 2021), psychological well-being (Hicks & Mehta, 2018) and subjective well-being (Jensen, Kirkegaard Thomsen, O'Connor & Mehlsen, 2020), it is negatively correlated with depression (Giota & Kleftaras, 2013) and anxiety (Cömertoğlu, 2021). When all these relationships are considered, it can be said that emotional stability is important for the adjustment of the individual.

Emotional stability includes improving one's quality of life by fostering self-acceptance, self-confidence, achievement and self-concept (Khoeriyah, Lubis, & Istichomah, 2018). Cyberostracism, on the other hand, is a common form of ostracism that is experienced during social interactions taking place in online environments (Nezlek, Wesselmann, Wheeler and Williams, 2012; Williams, et al. 2000). Cognitions and perceptions possessed by people may be impaired by the impact of cyberostracism (Lansu, van Noorden, & Deutz, 2017; O'Brien, Ellsworth, & Schwarz, 2012). Davidson et al. (2019) found that cyberostracism has a positive and significant relationship with emotional dysregulation. Wang, Mu, Li, Gu, and Duan (2020), in their study with university students, found a high level of negative and significant relationship between emotional well-being and cyberostracism and they also found that it is a significant predictor of emotional well-being. When the relevant literature is considered, it is thought that cyberostracism may have a negative predictive role on emotional stability.

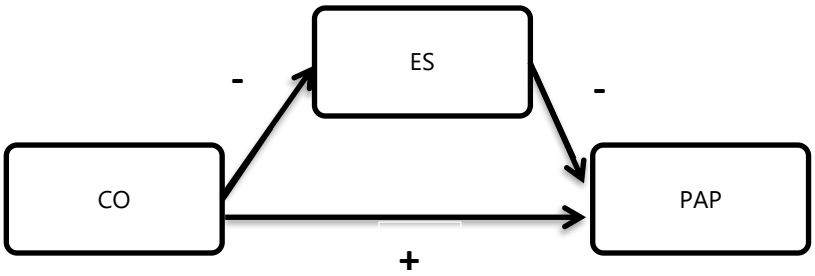
As stated by Brodsky (1988), the process of psychological adjustment involves normality, internal psychological adjustment, social competence and control of changing needs. Normality is the absence of problems arising from the individual's internal state or external social environment. Yıldırım and Solmaz (2021) found in their study that there is a positive and significant correlation between psychological adjustment problems and the variables of depression, anxiety and stress. Cruz, Petersonn, Fagan, Black, and Cooper (2019) found that there is a positive and high correlation between generalized anxiety disorder and psychological adjustment problems. Given the relationships expressed in the relevant literature, it can be thought that emotional stability may be negatively associated with the problems of psychological adjustment. Thus, it is thought that emotional stability may have a negative predictive role on the problems of psychological adjustment.

PURPOSE OF THE STUDY

In general, it is thought that cyberostracism may have an indirect effect on psychological adjustment problems through emotional stability, as well as having a direct effect on individuals' psychological adjustment problems. In other words, it is thought that emotional stability may have a mediator role between cyberostracism and the problems of psychological adjustment. In the literature, no study has been found that deals with the variables of cyberostracism, the problems of psychological adjustment and emotional stability together. In addition, an examination of these three variables together for a better and healthier understanding of the psychological adjustment of university students is thought to be important in terms of recognizing the psychological problems that students may experience both in their general and academic lives and taking the necessary precautions. In this regard, the purpose of the current study is to investigate the mediator role of emotional stability in the relationship between the cyberostracism and the problems of psychological adjustment among university students.

The hypothetical models and hypotheses established in line with the above-mentioned purpose of the study are given below.

Figure 1. *Hypothetical Model*



H_1: University students' cyberostracism predicts their psychological adjustment problems.

H_2: University students' cyberostracism predicts their emotional stability.

H_3: University students' emotional stability predicts their psychological adjustment problems.

H_4: Emotional stability has a mediator role in the relationship between the cyberostracism and the problems of psychological adjustment of university students.

METHOD

RESEARCH DESIGN

In this research correlational model was applied. The correlational pattern includes studies that provide an insight into the relationship between variables within a group, and often the probability of cause and effect between variables (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, and Demirel, 2012). In this research, correlational predictive model was implemented to investigate the mediator role of ES in the relationship between PAP and CO in university students.

PARTICIPANTS

The application was carried out at a state university located in The Central Anatolia Region of Türkiye. After obtaining the necessary permissions before the application, the course teachers were contacted and the application was made to the volunteer students. The participants of the research consist of 320 students, 71 (%22.19) male, 243 (%75.94) female, and 6 (%1.87) of whom do not specify their gender, studying in different departments.

DATA COLLECTION INSTRUMENTS

PSYCHOLOGICAL ADJUSTMENT SCALE (PAS)

PAS was developed by Cruz et al. (2019) and adapted to Turkish by Yıldırım and Solmaz (2020). The scale is consisted of 6 items and is 7-point Likert type (1=never 7=extremely) (Ex. Item. How nervous, anxious and/or scared did you feel this week?). Cronbach's α and McDonald's ω coefficients were calculated for reliability in the Turkish version of the PIQ, and both were found to be .88. In the current study, the Cronbach Alpha internal consistency coefficient was calculated as 0.91.

QUICK BIG FIVE PERSONALITY TEST (QBFPT)

Verlmuts and Gerris (2005) developed the QBFPT by using 30 of 100 adjectives about personality presented by Goldberg (1992). It was adapted into Turkish by Morsunbul (2014). There are six items for each personality factor. QBFPT is consisted of 30 items and is a 7-point Likert-type measurement tool (1= completely untrue, 7= completely true) (Ex. Item. Anxious). The Cronbach Alpha coefficients were calculated as .75 for emotional stability, .79 for extraversion,.81 for responsibility, .73 for agreeableness, and .69 for openness to experience. In the current study, only

the emotional stability dimension was used. In the study, the Cronbach Alpha internal consistency coefficient was calculated as 0.765 for emotional stability.

CYBEROSTRACISM SCALE (COS)

COS developed by Hatun and Demirci (2020). There are 14 items in the scale, which is 5-point Likert type scale (1=Never - 5=Always). (Ex. Item. They do not answer my questions on social media) The scale has 3 sub-dimensions. These sub-dimensions are Cyber Ignored, Cyber Indirect Excluded and Cyber Direct Excluded. The internal consistency of the scale was found to be .84 for the total score of Cyberostracism. In this study, the Cronbach Alpha internal consistency coefficient was calculated as 0.802 for COS.

DATA COLLECTION AND ANALYSIS

Within the scope of the research, firstly, permission was obtained from the owners of the measurement tools used in the research. In the next step, ethical permission was obtained from Selçuk University Faculty of Education Ethics Committee (16.03.2022-E.254131). Then, data was collected from the university students, who were volunteer after the required permission was got from university.

After the data were collected and entered into the SPSS program, firstly, missing data, wrong data entry, kurtosis and skewness values were examined before the data were analyzed. For the data obtained, first of all, normality assumptions for all models were examined. Furthermore, the kurtosis and skewness coefficients were checked to determine whether the univariate normality assumption was met. It is accepted that the +/- 2 values of kurtosis and skewness are acceptable values for the normal distribution (George & Mallery, 2010). In this study, as seen in Table 1, the kurtosis values for all scales were between -.545 and .437; the skewness values were found to be between .279 and .852. All kurtosis and skewness values were found to be at an acceptable level. By using the data, Pearson's correlation coefficients and Cronbach's alpha coefficients were calculated. Finally, Hayes's (2018) Model 4 was used to examine the mediator role of ES in the relationship between PA and CO.

FINDINGS

In this section, mean, standard deviation, kurtosis and skewness values of the variables, as well as the correlation coefficients between the variables and the mediation analysis results are included.

Table 1. *Mean, Standard Deviation, Kurtosis, Skewness, Pearson Correlation Coefficients for the Variables*

	M	*SD*	*Skewness*	*Kurtosis*	*1.PAP*	*2.ES*	*3.CO*
1.PAP	19.35	9.31	,596	-,545	1		
2.ES	28.93	6.69	-,279	-,465	-.54**	1	
3.CO	20.7	5.37	,852	,437	.21**	-.27**	1

*p<.01, PAP: Psychological Adjustment Problems ES: Emotional Stability CO: Cyberostrasicm

As seen in Table 1, there was positive, significant relationship between PAP and CO (r=.21, p<.01). In addition, negative, significant relationships were found between ES and CO (r=-.27, p<.01), and PAP and ES (r=-.54, p<.01).

Table 2. *Regression Analysis Results for Mediation Analysis (N=320)*

		Outcome Variables				
		M (ES)			*Y (PAP)*	
Predictive Variables		*b*	*S.E.*		*b*	*S.E.*
X (CO)	a	-.3325***	.0674	c'	.1148	.0848
M (ES)	-	-	-	b	-.7275 ***	.0680
Constant	i_M	35.8263***	1.4438	i_Y	38.0196***	2.9996
		R^2=.0710			R^2=.2964	
		F (1; 318)=24.3114; p<.001			F (2; 317)= 66.7609 ; p<.001	

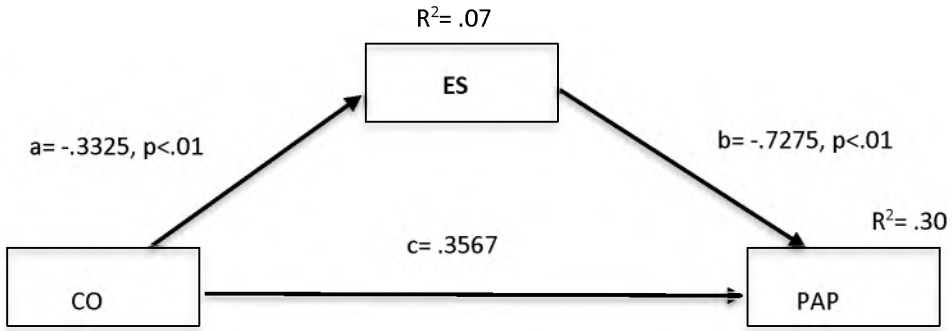
*p<.05; **p<.01; ***p<.001, S.e.=Standard error, Non-standardized beta coefficients (b) were reported.

Before the regression analysis, VIF values, Tolerance values (TV) and correlation coefficients between independent variables were calculated for some preconditions. For the regression model, the VIF value was 1.076, the TV was 0.927, and as seen in Table 1, the correlation between the independent variables (ES and CO) was also found to be -0.27. The TV value should be greater than 0.2, the VIF value should be less than 10 (Field, 2005), and the correlation between the independent variables (predictors) should be below .80 (Büyüköztürk, 2010; Field, 2005). It was seen that they took the necessary values before the regression analysis and there was no multicollinearity problem.

A regression analysis was conducted using the bootstrap method to test the mediator role of ES in the relationship between PAP and CO of university students. Hayes' (2018) model 4 was used for this analysis. In the analysis, 5000 resampling options were preferred with the bootstrap technique. The confidence intervals were used to determine whether CO had an indirect effect on PAP. The results obtained from the analyses were given in Table 2 and Figure 2.

According to the results obtained from the analysis, CO was found to negatively and significantly predict ES (*b*= -.3325, %95 CI [-.4652, -.1998], t=-4.9307, p<.001). CO also explained 7 % (R^2=.0710) of the variation in ES. ES was also found to predict PAP negatively and significantly (*b*= -.7275, %95 CI [-.8613, -.5937], t= 10.6999, p<.001). It was seen that the direct effect of CO on PAP was not significant (*b*= .1148, %95 CI [-.0521, .2817], t= 1.3535, p=.1768). Regarding mediation, the indirect effect of CO on PAP was significant; therefore, ES was found to mediate the relationship between PAP and CO (*b*=.2419, %95 CI [.1444, .3507]). In other words, ES was found to fully mediate the relationship between CO and PAP. CO and ES explained 30% (R^2=.2964) of the variation in PAP.

Figure 2. *The tested model and estimations*



Direct effect (c')= .1148, p>.05
Indirect effect= .2419, CI [.1444, .3507]
Note: Unstandardized values were reported.

DISCUSSION, CONCLUSION AND SUGGESTIONS

As a result of the analyses conducted within the context of the current study, it was found that the cyberostracism of the university students negatively and significantly predicted their emotional stability and positively and significantly predicted their psychological adjustment problems. The emotional stability of the university students was found to negatively and significantly predict their psychological adjustment problems. Moreover, emotional stability was found to have a mediator role in the relationship between the university students' cyberostracism and psychological adjustment. The findings obtained in the study are discussed below.

It was determined that the cyberostracism of the university students was a positive and significant predictor of their problems of psychological adjustment before the emotional stability variable was included. According to this finding, as the cyberostracism of the university students increased, their psychological adjustment problems also increased. Parallel to this finding, Riva, Wirth, and Williams (2011) found that cyberostracism is moderately correlated with psychological problems. In the study conducted by Hatun (2021), exposure to virtual social ostracism was found to increase the depression and anxiety levels of the participants and negatively affect their self-esteem. According to Galbava, Machackova, and Dedkova (2021), even a mild form of ostracism, such as strangers not reacting to a post shared, can have adverse emotional and behavioural results. When the findings obtained in the current study and the results reported in the related literature are considered, it can be said that cyberostracism negatively affects the psychological adjustment of university students.

As another finding of the study, the cyberostracism of the university students was determined to be a significant and negative predictor of their emotional stability. According to this finding, as the cyberostracism of the university students increased, their emotional stability decreased. Gonsalkorale and Williams (2007) found that the ostracism of individuals even by the members of a group that is not welcomed by the society causes negative feelings, and that ostracised individuals have a worse mood, lower belongingness and self-esteem than those included in the group. In a similar study conducted by Williams, Cheung, and Choi (2000), participants were played Cyberball in a computer environment, and it was found that the more ostracised the participants felt, the more they felt bad, the less control they had and the more they lost their sense of belonging. In another study, even the participants who were convinced that other players were controlled by the computer were uncomfortable when ostracised from the game (Zadro, Williams and Richardson, 2004). It can be said that the results of the above-mentioned literature are explanatory and supportive of the negative predictive role of the university students' cyberostracism on their emotional stability found in the current study.

As another finding of the study, it was determined that the emotional stability of the university students was a negative and significant predictor of their problems of psychological adjustment. According to this finding, as the emotional stability of the university students increased, their psychological adjustment problems decreased. Yablonska, Dembytska and Vus (2017) experimentally confirmed that emotional stability is among the factors that facilitate social-psychological adjustment, as a result of the research they conducted on the social-psychological adjustment of ex-soldiers after returning home from the battlefield. In the study conducted by Brooks and DuBois (1995) on university students, it was concluded that there was a significant positive relationship between their academic, personal and social adjustments and their emotional stability. Therefore, these findings are in line with the finding of the current study showing that emotional stability negatively predicts psychological adjustment problems.

As another finding of the study, it was determined that emotional stability plays a full mediator role in the relationship between the university students' cyberostracism and problems of psychological adjustment. In other words, it can be said that the cyberostracism experienced by the

university students negatively affected their emotional stability and in addition, it had an indirect and significant effect on their psychological adjustment problems. According to Seçer, Ulaş, and Karaman-Özlü (2020), when psychological adjustment is regarded as an ability used by the individual to cope with the difficulties of daily life, to control intense anxiety, depressive symptoms and stress factors, traumatic and challenging conditions of life may have an impact on the individual's psychological adaptation skills. Seen from this perspective, it can be said that cyberostracism, which is a compelling experience for university students, reduces the emotional stability, which is an important factor for psychological adjustment, and makes it difficult for students to adapt. If we take it from another point of view, as the internet and social media are becoming more popular, more and more social interactions take place in virtual environments. This makes the Internet an appropriate arena for many different kinds of social phenomena, one of which is ostracism (Borawski, 2022). In this internet arena, university students can interact with other people in social media, multiplayer games. During this interaction, they may feel ostracised in the face of situations such as being ignored by other participants or declared as unwanted, their messages' not being read or responded (Williams et al. 2002). This situation may prevent the satisfaction of basic needs (belonging, self-esteem, control, and meaningful existence) mentioned by Williams (2009), as shown in previous studies (Schneider et al. 2017; Smith, Morgan, & Monks, 2017). This situation may have adversely affected the emotional stability of the university students and made it difficult for them to adjust psychologically.

As the current study made some contributions to the explanation of the relationship between cyberostracism and the problems of psychological adjustment and the role of emotional stability in this relationship, it can be an important reference to future research on adjustment problems among university students. In this context, emotional stability can be included in the studies to be carried out to strengthen university students. Psycho-educational studies that strengthen emotional balance can be carried out. In addition, awareness trainings can be organized about psychological adjustment problems and cyberostracism. This study also has some limitations. The fact that the participants of the study were only university students can be considered as a limitation in terms of generalizability of the results. In this context, the model employed in the current study can be used with adolescents, parents, individuals from different occupational groups. The fact that the data collection tools of the research are in the form of self-assessment report can be seen as another limitation. The current study employed the quantitative method, future research can use qualitative methods or mixed methods to examine the results more deeply. In addition, longitudinal studies can be conducted to examine the long-term behavioural, cognitive, affective and psychosocial effects of cyberostracism on individuals.

AUTHOR CONTRIBUTIONS

- First author have made identified the research question, conducted the analyses, and drafted the manuscript

- Second author oversaw the design and execution of the larger study, assisted with interpreting the study findings, and collaborated in drafting and revising the manuscript. Both authors read and approved the final manuscript.

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REMOVED: Educational Research and Development Policies and Institutional Structures of Turkish Educational System

Keywords

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Abstract

This research aims to determine the current situation, expectations, problems, and solution suggestions regarding the structure and operation of the Provincial Directorates of National Education (PDoNE) R&D units. It was designed as a case study based on qualitative research. Data were collected from documents, and interviews with 14 teachers assigned in Türkiye's PDoNE R&D units using semi-structured forms. It was found that merit should be given importance in selection. Moreover, there is a title-authority imbalance and a lack of internal and inter-institutional cooperation and coordination. Only responsibilities are defined in the Ministry of National Education R&D Directives. Turkish Ministry's Educational R&D policies were carried out with scattered policy legislation and applications. It is recommended to rearrange the R&D Directive in the medium term and to combine the educational R&D units/departments in comprehensive legislation in the long run.

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The article titled "Educational Research and Development Policies and Institutional Structures of Turkish Educational System" was simultaneously uploaded and published in a different journal with the title "Teacher Perceptions and Expectations Regarding Research and Development in Education (R&D) Studies". The boards of both journals have decided to mutually remove these articles from their contents for the following reasons:

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Research Article

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The Prediction Level of the Students' Conflict Resolution Skills and Their Demographic Characteristics on Their Global Citizenship Perceptions

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Abstract

In today's world, individuals are expected to be vigilant for many problems in the world, such as environmental problems, war, migration, and poverty and take an active role in solutions to these problems. This responsibility expected of individuals is related to the concept of global citizenship, and for individuals to acquire global citizenship skills, they need to acquire many skills related to conflict resolution. The aim of this study is to first determine the global citizenship perceptions and conflict resolution skill levels of fourth-grade primary school students, and then, to determine to what extent conflict resolution skills and some other variables predict global citizenship perceptions. This is a predictive and correlational study. The quota sampling method was used in this study. The sample of the study consisted of 320 fourth-grade primary school students. A personal information form, the Global Citizenship Perception Scale, and the Conflict Resolution Skills Scale were used to collect the data. In the analysis of the data, Pearson's product-moment correlation analysis and multiple regression analysis were used as well as descriptive statistics. As a result of the analyses, a significant relationship was found between the global citizenship perceptions of the participants and their scores of resorting to reconciliation and violence. Moreover, all the predictive variables used in the multiple regression model were significant, and they collectively explained 20.6% of the total variance in the global citizenship perceptions of the participants.

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INTRODUCTION

Many developments in today's world require individuals to be aware of the problems not only in their surroundings but also all over the world. Many reasons such as globalization, migration, the development of information and communication technologies, and the more prevalent coexistence of different cultures have triggered this situation. In today's world, individuals are expected to be vigilant for many problems in the world, such as environmental problems, war, migration, and poverty and take an active role in solutions to these problems. This responsibility expected from individuals is associated with the concept of global citizenship. Global citizenship is closely related to many competencies such as being sensitive to all world problems, caring for all individuals, being free of from prejudices, and having a peaceful perspective. It can be stated that individuals who respect differences, are tolerant and care about other individuals also have global citizenship competencies. All these qualities also highlight the importance of conflict resolution skills. In this case, as stated in the literature, some of the characteristics that global citizens should have conflict resolution skills. In this context, it may be stated that the perceptions of individuals regarding global citizenship and their possession of conflict resolution skills are among the issues that need to be examined. Additionally, in the review of the literature on this subject, no study examining the relationship between global citizenship perceptions and conflict resolution skills was encountered.

CONCEPTUAL FRAMEWORK

Nowadays, in light of global developments, individuals face not only problems around them but also developments and problems around the world. Therefore, for individuals to be able to live in a society harmoniously, they need to have global citizenship characteristics. The concept of global citizenship is based on the acceptance of the unity of nations around the world and refers to unity within diversity (Yaşar, 2008). The foundations of global citizenship may be listed as the elimination of geographical dependencies, increased importance of a universal identity, sensitivity towards global issues, and the prominence of activism (Falk, 1994).

A global citizen is not only a citizen of their country, but of a world for which they take responsibility. A global citizen is a universal personality who considers events from the perspective of humanity and tries to leave a sustainable life to future generations (Kan, 2009). Being a global citizen requires having a universal perspective. In other words, the global citizen has characteristics such as thinking universally, evaluating the problems occurring all over the world from a universal perspective, and being vigilant regarding both natural and social environments (Laszlo, 2004; Balbağ, 2016). Oxfam (2014) listed the characteristics of global citizens as awareness of one's own role as a citizen of the wider world, valuing and respecting diversity, understanding the working mechanisms of the world, opposing social injustice, engaging in communities locally and globally, being prepared for any action to make the world fairer, and taking responsibility for own behaviors.

The fact that global events and issues affect the entire world makes it important for individuals to have global citizenship characteristics. The possession of these characteristics by individuals is undoubtedly closely related to education-teaching processes. In this context, it is necessary to give importance to global citizenship education in schools where planned and regular education is carried out, to raise vigilant citizens (Banks, 2008). UNESCO (2014) stated the elements of global citizenship education as follows:

- Critically examining real-life problems and creating innovative solutions to these problems
- Enabling students to re-evaluate their views
- Consideration of groups that are considered marginal in society
- Inclusion of multiple stakeholders outside the learning environment
- To ensure the realization of the desired changes by focusing on individual and social goals

Education on global citizenship should be founded upon strong relationships in society (Parker, 2002). This education should cover the development of inquiry and critical thinking skills, equipping students with the knowledge, skills, and values that are necessary to become active citizens, providing them with knowledge of global issues, and having them understand that they are a part of the global world (Oxfam, 2006). The main focus of global citizenship education is the individual. This is because it is important to raise individuals who can overcome problems such as war, poverty, injustice, and environmental pollution with global citizenship education, think about the whole world as well as their country without losing their own identity, acknowledge intercultural differences, and approach these differences with tolerance. Additionally, raising individuals with global responsibility is among the objectives of this form of education (Çolak, 2019). In addition to these, it may be stated that there are some skills that should be gained to individuals in global citizenship education. These skills, which were also stated by Oxfam (2014), are shown in Table 1.

Table 1. *Global Citizenship Skills*

Knowledge and understanding	*Skills*	*Values and attitudes*
Social justice and equality	Critical thinking	Identity and self-esteem
Diversity	Effective discussion	Empathy
Globalization and dependency	Fighting against injustice and inequality	Responsibility for social justice and equality
A sustainable future	Respect for people and goods	Respect and value for differences
Peace and conflict	*Cooperation and conflict resolution*	Taking care of the environment and taking responsibility for sustainable development
		Believing that people can make a difference

As seen in Table 1, the skills that global citizens should possess have been discussed in three dimensions: knowledge and understanding, skills, and values and attitudes. Accordingly, equality, peace, and conflict under the dimension of knowledge and understanding, critical thinking, effective discussion, respect, cooperation, and conflict resolution under the dimension of skills, and variables such as empathy and respect for differences under the dimension of values and attitudes are directly related to conflict resolution skills. In this case, for individuals to develop global citizenship skills, they need to develop many skills related to conflict resolution. In this context, it is possible to state that there is a relationship between conflict resolution skills and global citizenship.

Conflict resolution is one of the important skills that individuals should have because conflicts are inevitable in the lives of individuals. Individuals experience conflict both within themselves and with others. The prevention of individuals from not harming other individuals to achieve their own goals depends on resolving their conflicts in a constructive manner. Resolving conflicts in a constructive manner requires individuals to have skills to communicate, discuss, and cooperate (Gürdoğan-Bayır, 2015). Conflict resolution is a collection of knowledge and practices that change the perspectives of individuals on the world (Snyder, 2007) and a process in which the parties come to an agreement (Sadri, 2013). It may be stated that the resolution of the conflicts of parties by reaching a compromise is related to their acquisition of conflict resolution skills.

The development of conflict resolution skills is required for taking lessons from the potential situations that can arise due to conflicts and mitigating their harmful effects (Karip, 2013). When they are addressed correctly, conflicts provide opportunities for learning and contribute to the development of children (Andrews, 2000; Schrumpf, Crawford, & Bodine, 1997/2007). Therefore, conflict resolution education should be given in schools as schools should be places of peace and quality education. Additionally, conflict resolution skills support educational objectives such as cognitive curiosity, motivation to learn, and creative problem-solving. This aspect of education will

ensure that conflicts are resolved through constructive processes on national, international, family, and community scales (Johnson & Johnson, 1994).

Teaching conflict resolution skills not only provides trust and peace at schools but also increases the quality of instruction. This situation encourages students to attend school eagerly and motivates them (Bilgin, 2008a). Learning takes place in a safe environment. Thus, at schools, students should be taught about peaceful methods and educated for the development of their conflict resolution skills (Öner, 2006). For students to become able to resolve conflicts effectively when they encounter them, they should be taught skills such as effective listening, collaboration, awareness regarding prejudice, and problem-solving skills in the context of skill-based activities (Collins, 2002). Furthermore, it is also considered important for school administrators to realize that conflict resolution is an instrument for eliminating violence (Schrumpf, Crawford, & Bodine, 1997/2007). Providing education on conflict resolution at the stage of primary school will contribute significantly to the prevention of violence in further steps of education (Akgün & Araz, 2010).

Primary schools cover the critical years of the lives of students for them to adopt several different values, skills, attitudes, and habits. These schools aim to ensure that children adapt to social life and become qualified citizens. This is because they aim to raise responsible citizens and successful individuals (Güler, Demir, Kılıç, & Demir, 2020 cited in Özben 1997). Similarly, raising students as global citizens will be possible by equipping them with global citizenship knowledge, skills, values, and attitudes at early ages (Balbağ, 2016). Hence, this study, which discusses the concept of global citizenship and different variables linked with this concept, was carried out with primary school students.

Many variables that affect the perceptions of students regarding global citizenship can be addressed. There are studies in the literature that have examined whether global citizenship perceptions vary according to gender (Balbağ, 2016; Çakmak, Bulut, & Taşkıran, 2015; Çermik, 2015; Göl, 2013; Gül, 2020; Karaca & Çoban, 2015; Kaya & Kaya, 2012; Şahin, Şahin, & Gökebakan Yıldız, 2016). There are also studies (Balbağ, 2016; Çermik, 2015; Durualp, 2016; Göl, 2013; Göz, Balbağ, & Çermik, 2015; Sağlam, 2000) that have investigated the citizenship perceptions of students in terms of the number of their siblings, their parental education levels, and their income status. Having access to or using the internet, reading newspapers, and going abroad are among other variables investigated in this regard (Balbağ, 2016; Çakmak, Bulut, & Taşkıran, 2015; Engin & Sarsar, 2015; Kaya & Kaya, 2012). In this study, taking the literature into account as well, gender, socioeconomic characteristics (number of residents at home, number of siblings, educational status of parents, income status of the family), internet access status at home, status of reading newspapers, and status of going abroad were considered as predictive independent variables. In this context, in this study, the variables in question were discussed based on the literature. Accordingly, the aim of this study is to first determine the global citizenship perceptions and conflict resolution skill levels of fourth-grade primary school students, and then, to determine to what extent conflict resolution skills and some other variables predict their global citizenship perceptions. Thus, the following questions were addressed in the study:

1. What are the global citizenship perceptions and conflict resolution skill levels of fourth-grade primary school students?
2. Are the global citizenship perceptions of fourth-grade primary school students predicted by their
    - Conflict resolution skills
    - Gender
    - Number of residents in the house
    - Number of siblings
    - Mother's Education Level

- Father's *Education Level*
- *Level of internet access at home*
- Newspaper reading status
- Average monthly income
- Status of going abroad?

METHOD

RESEARCH DESIGN

This is a predictive study that was carried out with a correlational design as a quantitative research method. In a correlational design, the researchers use correlation analyses to measure the degree of or describe the relationship between two or more variables. There are two main correlational designs, namely explanatory and predictive designs (Creswell, 2012). In this study, it was aimed to investigate the global citizenship perceptions and conflict resolution skill levels of fourth-grade primary school students and determine the extent to which their conflict resolution skills and some other variables predicted their perceptions of global citizenship. The dependent variable of the study was the perceptions of the participants on global citizenship, and the predictive variables were conflict resolution skills, gender, number of residents at home, number of siblings, education levels of parents, internet access levels at home, newspaper reading status, average monthly income, and some demographic variables in regard to going abroad.

POPULATION AND SAMPLE

The population of this study consisted of fourth-grade primary school students in the central districts of Eskişehir, Turkey. The demographic characteristics of the participants are given in Table 2.

Table 2. *Demographic Characteristics of the Participants*

	n	*%*		*n*	*%*
Gender			*Internet at Home*		
Female	158	49.4%	Yes	287	89.7%
Male	162	50.6%	No	33	10.3%
Mother's Education Level			*Average Monthly Income*		
Illiterate	3	1.0%	1001-2000	67	22.9%
Primary School	44	14.2%	2001-3000	77	26.4%
Secondary School	45	14.6%	3001-4000	63	21.6%
High School	104	33.7%	4000 or above	85	29.1%
University	113	36.6%	*Number of residents in the house*		
Father's Education Level			2	5	1.6%
Illiterate	1	0.3%	3	47	14.9 %
Primary School	34	11.0%	4	178	56.3%
Secondary School	25	8.1%	5 or above	86	27.2%
High School	111	36,0%	*Number of Siblings*		
University	137	44.5%	1	63	19.9%
Has Been Abroad			2	184	58.2%
Yes	60	18.8%	3	60	19,0%
No	260	81.2%	4 or above	9	2.8%
Newspaper Reading					
Yes	60	18.8%			
No	260	81.2%			

The quota sampling method was used in this study to select participants from the population. In this method, the researchers divide the population into predetermined categories, and they select participants from each category by convenience sampling as a non-probability sampling method (Özen & Gül, 2007). Considering the socioeconomic conditions of the schools, the lower, middle, and upper

socioeconomic levels were determined as the strata. When sampling from each stratum, schools that the researchers could easily reach were taken into consideration. Accordingly, 320 fourth-grade primary school students constituted the sample of the study. As seen in Table 2, 50.6% of the participants were male, and 49.4% were female. The mothers of 33.6% of the participants and the fathers of 44.5% were university graduates. It was found that 81.2% of the participants had not been abroad and did not read newspapers, and 89.7% did not have an internet connection at home. While 29.1% of the participants had an average household income of 4000 or above, 56.3% had 4 people in their families, and 58.2% had 2 siblings.

DATA COLLECTION INSTRUMENTS

A personal information form, the Global Citizenship Perception Scale, and the Conflict Resolution Skills scale were used to collect the data.

PERSONAL INFORMATION FORM

This form that was developed by the researchers was used to collect information on the personal characteristics and some predictive variables of the participants. The examined variables included gender, educational status of parents, internet access at home, reading newspapers, going abroad, average monthly income, number of people in the house, and number of siblings.

GLOBAL CITIZENSHIP PERCEPTION SCALE

The Global Citizenship Perception Scale, which was developed by Balbağ (2016), was used to determine the global citizenship perceptions of the participants. The unidimensional scale, which consists of a total of 18 items, is graded as a 4-point Likert-type scale where each item has the response options of strongly disagree, disagree, agree, and strongly agree. In the analyses of the scale that were conducted by Balbağ (2016) with the participation of 288 students, the Keiser-Meyer-Olkin (KMO) statistic of the scale was found as 0.95. The result of the Bartlett's test of sphericity was significant (χ^2=2247.775; df=153; p<0.001). As a result of the exploratory factor analysis (EFA), the factor loads of the items of the scale were found to be in the range of 0.48 to 0.84. Additionally, the single factor of the scale items explained 45.41% of the total variance in the scale scores. The internal consistency coefficient of the scale was reported as 0.92, which indicated high reliability. According to the results of the confirmatory factor analysis (CFA), the χ^2/df statistic that was smaller than 2 showed an excellent fit, the RMSEA value of 0.038 showed an excellent fit, the standardized SRMR value of 0.062 showed a good fit, the NNFI value of 0.97 showed an excellent fit, the CFI value of 0.98 showed an excellent fit, the GFI value of 0.58 showed a moderate fit, and the AGFI value of 0.88 showed a moderate fit (Çokluk et al., 2010). In this context, the factor structure of the scale was confirmed by the author.

In this study, the scale was subjected to an EFA again. According to the results of the EFA, the factor load values of the items in the single-factor scale varied between 0.729 and 0.345, and the single factor of the scale explained35.9% of the total variance in the scale scores. The internal consistency coefficient of the scale, obtained from the responses of the 320 participants of this study, was calculated as α=0.88. According to the results of the KMO-MSA tests and Bartlett's test of sphericity, which were conducted to determine the suitability of the sample for factor analysis, the data collected with the Global Citizenship Perception Scale met the appropriate requirements for modeling with the factor analytical model (KMO-MSA: 0.915; Bartlett's p<0.05).

To confirm the factor structure of the scale in this study, another CFA was conducted using the data of 217 of the participants who were randomly selected. Accordingly, it was determined that the χ^2/df goodness of fit index that was lower than 2 showed an excellent fit, the RMSEA value of 0.065 showed an acceptable fit, the SRMR value of 0.057 showed a good fit, the NNFI value of 0.96 showed an excellent fit, and the CFI value of 0.97 showed an excellent fit (Çokluk et al., 2010). Hence, it may

be stated that the factor structure of the Global Citizenship Perception Scale was confirmed in the sample of this study.

CONFLICT RESOLUTION SKILLS SCALE

The Conflict Resolution Skills Scale developed by Gürdoğan-Bayır (2015) was used to determine the conflict resolution skill levels of the participants. The scale, which consists of a total of 22 items, is scored as a 4-point Likert-type scale in which each item has the response options of strongly disagree, disagree, agree, and strongly agree. It consists of two dimensions, 'Resorting to Reconciliation' and 'Resorting to Violence'. In the analyses conducted by Gürdoğan-Bayır (2015) with the participation of 277 students, the KMO statistic of the scale was found as 0.94. The result of the Bartlett's test of sphericity was also found significant (χ^2=5787,383; df=703; p<0.001). According to the EFA results, the two factors of the scale explained 49.60% of the total variance in the scale score. Therefore, in the analyses of the author, the 'Resorting to Reconciliation' factor consisted of 14 items and explained 32.42% of the total variance in scores. The factor load values of the items in this dimension varied between 0.53 and 0.74. The 'Resorting to Violence' factor consisted of 8 items and explained 17.18% of the total variance. The factor load values of the items in this dimension varied between 0.66 and 0.55. Based on an internal consistency coefficient of 0.92, the scale was found highly reliable. In the CFA conducted by the author, the χ^2/df goodness of fit index value that was lower than 2 showed an excellent fit, the RMSEA value of 0.033 showed an excellent fit, the standardized RMR value of 0.062 showed a good fit, the NNFI value of 0.97 showed an excellent fit, the CFI value of 0.98 showed an excellent fit, and the GFI value of 0.87 showed a moderate fit (Çokluk et al., 2010). In this context, the factor structure of the scale was confirmed by the author.

In this study, the scale was used after performing another EFA. According to the EFA results, the factor load values of the items of the two-factor scale consisting of 22 items varied between 0.465 and 0.802, while the two factors explained 37.9% of the total variance in the scale scores. The internal consistency coefficient obtained from the responses of the 320 students in the sample of this study was calculated as 0.94 for the dimension of resorting to reconciliation and 0.89 for the dimension of resorting to violence. According to the results of the KMO-MSA tests and Bartlett's test of sphericity, which were conducted to determine the suitability of the sample for factor analysis, the data collected with the Conflict Resolution Skills Scale met the appropriate requirements for modeling with the factor analytical model (KMO-MSA: 0.944; Bartlett's p<0.05).

To confirm the factor structure of the scale in this study, another CFA was conducted using the data of 264 of the participants who were randomly selected. Accordingly, it was determined that the χ^2/df goodness of fit index that was lower than 2 showed an excellent fit, the RMSEA value of 0.063 showed an acceptable fit, the SRMR value of 0.052 showed a good fit, the NNFI value of 0.98 showed an excellent fit, and the CFI value of 0.98 showed an excellent fit (Çokluk et al., 2010). Hence, it may be stated that the factor structure of the Conflict Resolution Skills Scale was confirmed in the sample of this study.

DATA ANALYSIS

The data collection forms were administered by the researchers based on voluntary participation at schools in the provincial center of Eskişehir. The collected data were coded in the digital environment and analyzed using the IBM SPSS 21 program. Before data analysis, the forms that were filled out incompletely or incorrectly were identified and removed. Moreover, to determine whether the data on the scale scores of the participants were normally distributed, skewness and kurtosis values were calculated. These values are presented in Table 3.

Table 3. *Skewness and Kurtosis Values of Scale Scores*

Dimension	*Kurtosis (S. Error: 0.271)*	*Skewness (S. Error: 0.136)*
Global Citizenship Perception Scale	1.781	-1.462
Resorting to Reconciliation	1.273	-1.354
Resorting to Violence	-0.285	0.844

As seen in Table 3, because the skewness and kurtosis values of the scale scores were between -2 and +2, it was decided to conduct parametric analyses (Tabachnick & Fidell, 2012). After these procedures, the data were analyzed for a total of 320 participants. In addition to descriptive statistics (percentages, frequencies), the analyses included Pearson's product-moment correlation analysis and multiple regression analysis. The regression analysis was conducted by including all independent variables together as a single block. Dummy variable coding was performed for the variables of gender, internet connection at home, regular newspaper reading, and experience going abroad. To test the presence of a multicollinearity problem in the regression analysis, tolerance and variance inflation factor (VIF) values were calculated (Table 6), and it was found that these values were within acceptable ranges (Büyüköztürk, 2002). In the interpretations of the mean scores of the scales, while determining their cut-off points, the formula (n-1)/n was used as the scales were in a Likert-type form. According to these calculations, these ranges were determined as 1-1.75=very low, 1.76-2.50=low, 2.51-3.,25=high, and 3.26-4.00=very high.

FINDINGS

In this section, the findings obtained in the study are presented in sub-headings in accordance with the objectives.

FINDINGS ON GLOBAL CITIZENSHIP PERCEPTIONS AND CONFLICT RESOLUTION SKILL LEVELS

In this study, which was conducted to determine the conflict resolution skills of fourth-grade primary school students and identify the extent to which some variables predicted their perceptions of global citizenship, the results regarding the mean, standard deviation, and percentile values of global citizenship perceptions and conflict resolution skill levels were as given in Table 4.

Table 4. *Mean, Standard Deviation, and Percentile Values of Scale Scores*

Scales	*N*	*Minimum*	*Maximum*	$\overline{X}$	*SD*
Global Citizenship Perception	320	1.44	4.00	3.4872	0.40880
Conflict Resolution Skills					
Resorting to Reconciliation	320	1.00	4.00	3.2260	0.77723
Resorting to Violence	320	1.00	4.00	1.9551	0.85179

As seen in Table 4, the mean scores of the participants were found as 3.48 in the Global Citizenship Perception Scale, 3.22 in the dimension of resorting to reconciliation in the Conflict Resolution Skills Scale, and 1.95 in the dimension of resorting to violence in the Conflict Resolution Skills Scale. Accordingly, the global citizenship perceptions of the participants were 'very good'. While the scores of the participants in terms of resorting to reconciliation, which is one of the dimensions of the Conflict Resolution Skills Scale, were 'very good', it was seen that their scores were 'low' in the dimension of resorting to violence. This leads to the conclusion that the participants did not prefer to resort to violence in conflict situations, while instead, they preferred to resort to reconciliation.

FINDINGS ON THE CORRELATIONS OF THE PREDICTIVE VARIABLES OF GLOBAL CITIZENSHIP PERCEPTIONS

The correlation coefficients between the predicted and predictive variables in the study are given in Table 5.

Table 5. *Correlations between Variables*

	Global Citizenship
Resorting to Reconciliation	0.482**
Resorting to Violence	-0.316**
Number of residents in the house	-0.093
Number of siblings	-0.084
Mother's Education Level	0.136*
Father's Education Level	0.140*
Average monthly income	0.019

**. significance at 0.01 level; *. significance at 0.05 level

It is seen in Table 5 that there were significant relationships between the global citizenship perception scores of the participants and their scores of resorting to reconciliation and violence, as well as between their global perception scores and some other variables. The highest correlation coefficient between' the global citizenship perception scores of the participants and the other variables was found for the resorting to reconciliation variable, followed by the variable of resorting to violence in the negative direction, the education levels of the father and mother in the positive direction, the number of people in the house, and the number of siblings in the negative direction. As the number of people and siblings in the houses of the participants increased, there was a decrease in their positive perceptions of global citizenship. Additionally, as the education levels of the parents of the participants increased, their positive perceptions of global citizenship also increased.

While the correlation between the students' Global Citizenship perception scores and the dimension of Resorting to Reconciliation was calculated in the positive direction (r=.48), it was calculated in the negative direction (r=.31) in the dimension of Resorting to Violence. Moreover, it was seen that while the tendency of the participants to resort to reconciliation while resolving conflict situations increased, their positive perceptions of global citizenship also increased. It was also revealed that while the tendency of the participants to resort to violence while resolving conflict situations increased, their positive perceptions of global citizenship tended to decrease.

REGRESSION ANALYSIS ON PREDICTING THE GLOBAL CITIZENSHIP PERCEPTION SCORES OF THE PARTICIPANTS

The results of the regression analysis regarding the prediction of the global citizenship perception scores of the participants are given in Table 6.

Table 6. *The Extent to Which the Conflict Resolution Skills and Some Demographic Variables of the Participants Predicted Their Global Citizenship Perceptions*

	Non-standardized Coefficients		*Standard. Coefficients*	*T*	*p*		
Model	*B*	*Std. Err.*	*β*			*Paired r*	*Partial r*
(Constant)	3.360	0.306		10.963	0.000		
Resorting to Reconciliation	0.196	0.032	0.367	6.133	0.000	0.357	0.341
Resorting to Violence	-0.030	0.030	-0.061	-0.999	0.319	-0.062	-0.056
Gender	-0.104	0.047	-0.129	-2.227	0.027	-0.138	-0.124
Number of people in the house	-0.028	0.039	-0.059	-0.725	0.469	-0.045	-0.040
Number of siblings	0.001	0.046	0.002	0.029	0.977	0.002	0.002
Mother's Education Level	0.010	0.027	0.027	0.379	0.705	0.024	0.021
Father's Education Level	0.017	0.028	0.042	0.613	0.540	0.038	0.034
Internet Availability at Home	-0.126	0.078	-0.092	-1.621	0.106	-0.101	-0.090
Newspaper Reading	-0.054	0.061	-0.050	-0.883	0.378	-0.055	-0.049
Average monthly income	0.008	0.022	0.022	0.353	0.724	0.022	0.020
Going abroad	-0.032	0.062	-0.032	-0.515	0.607	-0.032	-0.029

a. Dependent Variable: perception of global citizenship

R: 0.454 R^2: 0.206 $F_{(11\text{-}257)}$: 6.060 p:0.000

In Table 6, along with the scores of the participants on the scales and subscales, the results of the multiple regression analysis showing the extent to which demographic variables such as gender, number of people in the house, number of siblings, mother's education level, father's education level, internet availability at home, regular newspaper reading, average monthly income, and experience of going abroad predicted their global citizenship perceptions are presented. According to the analysis results, when all predictive variables used in the multiple regression model were examined, they collectively predicted 20.6% of the total variance in the perceptions of the participants regarding global citizenship (R^2: 0.206, F(11-257):6.060, p<0.001). The variables that significantly predicted the global citizenship perceptions of the participants were their scores in the reconciliation subscale (β:0.367, t: 6.133, p<0.001) and gender (β:-0.129, t: -2.227, p<0.05). Based on these results, it can be stated that an increase in the reconciliation skills of the participants predicted a significant increase in their positive perceptions of global citizenship. Additionally, considering the predictive effect of the gender variable (girl: 0, boy: 1), which was introduced in the model by dummy variable coding, it was seen that the female participants had a significantly more positive global citizenship perception.

Other independent variables in the multiple regression model, including resorting to violence, number of people in the house, number of siblings, mother's education level, father's education level, internet availability at home, regular newspaper reading, monthly average income, and experience going abroad were not found to have a significant predictive effect on their own (p>0.05). According to the findings, the regression equation for global citizenship perceptions was as follows:

Perceptions of global citizenship= 3.360+ [(Reconciliation) x (0.196)] + [(Resorting to violence) x (-0.030)] + [(Gender) x (-0.104)] + [(Number of people at home) x (-0.028)] + [(number of siblings) x (0.001)] + [(Mother's education level) x (0.010)] + [(Father's education level) x (0.017)] + [(Internet availability at home) x (-0.126)] + [(Newspaper reading) x (-0.054)] + [(Average monthly income) x (0.008)] + [(Experience going abroad) x (-0.032).

DISCUSSION, CONCLUSION, AND IMPLICATIONS

In this study, which was conducted to determine the extent to which the conflict resolution skills of fourth-grade primary school students and some other variables predicted their perceptions of global citizenship, it was concluded that the global citizenship perceptions of the participants were "very good". The highly positive perceptions of the participants of this study regarding global citizenship may have been influenced by their gains from the Social Studies course. This is because this course covers values such as respect for differences, getting to know different cultures, and respecting these cultures (MEB, 2018). Again, in the study conducted by Balbağ (2016) with primary school students, it was determined that the perceptions of the participants regarding global citizenship were very good. Similarly, in the study conducted by Gül (2020) with university students, it was determined that the perceptions of the participants regarding global citizenship were highly positive, similar to the results of this study. However, in studies in the literature with prospective teachers and university students studying in different fields, moderate global citizenship perceptions have been reported (Alabay & Yağan Güder, 2019; Çermik, 2015; Douglass, 2020; Engin & Sarsar, 2015; Kayışoğlu, 2016; Şahin, Şahin, & Göğebakan Yıldız, 2016; Temel, 2016). In qualitative studies conducted with prospective teachers, it has also been determined that prospective teachers cannot define global citizenship in depth (Bruce, North, & Fitzpatrick, 2019; Egüz, 2016; Günel & Pehlivan, 2016). As seen here, it was determined that both quantitative and qualitative studies conducted with teachers, prospective teachers, and university students in the literature did not show any similarity to the results of this study. It can be stated that this situation may be due to the differences between the samples of different studies. The fact that the participants of this study, who were primary school students, were not on a developmental level adequate to comprehend the issue in depth may have led them to have more positive perceptions. This is because primary school students are in the concrete operational stage in terms of their cognitive and developmental characteristics.

In this study, the conflict resolution skills of the participants were demonstrated within the scope of the factors of resorting to reconciliation and resorting to violence. Based on these analyses, it was concluded that the participants were "very good" in the dimension of resorting to reconciliation for conflict resolution and "moderate" in the dimension of resorting to violence. It was previously reported that the conflicts experienced by children originate from limited sources in general, that is, they experience a set of conflicts during queuing at the cafeteria or for computer usage (Ergül, 2008). Such conflicts are considered the easiest conflicts to resolve (Schrumpf, Crawford, & Bodine, 1997/2007). Therefore, it may be stated that children have good conflict resolution skills. In the literature, experimental studies have aimed at improving the conflict resolution skills of students. In such studies, using different approaches and methods, the conflict resolution skills of students have been improved (Bilgin, 2008b; Bortner, 2004; Burnes, 2007; Catterall, 2007; Ergül, 2008; Gündoğdu, 2009; Gürdoğan-Bayır, 2015; Mutluoğlu & Serin, 2012; Sarı, 2005; Tapan, 2006; Taştan, 2004; Warner, 2005). Therefore, with the appropriate activities to be organized, the acquisition of competencies by students in this regard can be facilitated. In addition to these studies in the literature, there are also studies that have examined how individuals in different age groups resolve their conflicts. While some of these studies have supported the results of this study with regard to the ways that students prefer to resolve conflicts, some of them have contradicted the results of this study. For example, in a study conducted with university students, it was determined that the students generally resolved their conflicts through compromise (Dinçyürek & Civelek, 2010). In another study, it was revealed that prospective teachers used avoidance and verbal aggression more frequently compared to physical aggression (Keleş & Alisinanoğlu, 2012). In a study conducted with teachers by Jenkins, Ritblatt, and McDonald (2008), it was found that teachers resolved their conflicts with cooperative strategies. In a study conducted with children and adolescents, it was concluded that adolescents resolved their conflicts with devastating methods such as physical violence and name-calling (Ayaş et al., 2010; Leventhal, 2007; Türnüklü & Şahin, 2004; Yavuzer, Karataş, & Gündoğdu, 2013). As seen here, the results of studies conducted with adolescents generally contradict with the results of this study in terms of resorting to reconciliation. It can be stated that this may be caused by some developmental changes experienced by adolescents.

As a result of this study, a significant relationship was observed between the perceptions of the participants regarding global citizenship and their scores of resorting to reconciliation and violence. The closest relationship of the citizenship perceptions of the participants was with their scores in the dimension of resorting to reconciliation. Likewise, a negative significant relationship was determined between the global citizenship perceptions of the participants and their scores in the dimension of resorting to violence. Accordingly, while the tendency of the participants to resort to reconciliation while resolving conflict situations increased, their positive perceptions of global citizenship also increased, and it was concluded that while their tendency to resort to violence while resolving conflict situations increased, their positive perceptions of global citizenship decreased. Studies in the literature that have investigated global citizenship characteristics have determined some attributed that could support peaceful conflict resolution. For example, Oxfam (2014) reported that qualities such as communication, conflict resolution, respect for differences, and peace are among the characteristics that global citizens should have. In the study conducted by Gürdoğan-Bayır, Göz, and Bozkurt (2014) with prospective teachers, it was seen that the prospective teachers specified characteristics such as empathy, problem-solving, and being peaceful among their perceived global citizenship characteristics. Lima and Brown (2007) included respect for differences, benevolence, and responsibility for different cultures while elaborating on the characteristics of global citizens (cited in Baysal and Tanrıseven, 2020). Considering reports in the relevant literature, individuals with high levels of positive perceptions of global citizenship are those who are respectful to differences, can empathize and solve their problems in peaceful ways. Therefore, the results revealed in this study that the positive perceptions of the participants regarding global citizenship increased as their use of reconciliation in the conflict resolution process increased was supported by the literature.

It was concluded in this study that there are significant relationships between the global citizenship perceptions of the participants and some of their variables. A positive relationship was found between the education levels of the mothers and fathers of the participants and the global citizenship perceptions of the participants, and there was a negative relationship between the variables of number of residents and siblings in the house and their global citizenship perceptions. As the number of people and siblings in the houses of the participants increased, there was a decrease in their positive perceptions of global citizenship. In their study conducted with primary school teachers, Çelikten (2015) examined whether there was a significant difference in global citizenship perceptions based on having a nuclear family or an extended family, and no significant relationship was identified between these variables. As the education levels of the parents of the participants of this study increased, their positive perceptions of global citizenship also increased. However, some studies in the literature have not demonstrated a significant relationship between global citizenship perceptions and parental education levels (Balbağ, 2016; Çermik, 2015; Göl, 2013; Kaya, 2020). As seen here, some studies have supported the results of this study, while some have contradicting results. This may be due to the fact that the studied samples had different ages, lived in different regions, and thus, differed in terms of their experiences.

In this study, to determine the extent to which the global citizenship perceptions of the participants were predicted by their conflict skill scale and subscale scores, as well as other variables, a multiple regression analysis was performed using the variables of gender, number of people at home, number of siblings, mother's education level, father's education level, internet availability at home, regular newspaper reading, monthly average income, and experience going abroad. According to the results, when all predictive variables used in the multiple regression model were examined together, it was determined that they predicted the dependent variable to a statistically significant degree and collectively explained 20.6% of the total variance in the global citizenship perceptions of the participants. In the separate examinations of the variables, it was observed that the scores obtained from the reconciliation subscale and the gender variable were significant predictors. Based on these results, it was determined that an increase in the reconciliation skills of the participants caused a significant increase in their positive perceptions of global citizenship. It was seen that the positive global citizenship perception levels of the female participants were significantly higher than those of the male participants. Other independent variables in the multiple regression model, including resorting to violence, number of people in the house, number of siblings, mother's education level, father's education level, internet availability at home, regular newspaper reading, monthly average income, and experience going abroad were not determined to be significant predictors on their own.

Consequently, in this study, it was determined that there is a relationship between the global citizenship perceptions and conflict resolution skills of fourth-grade primary school students. This situation is supported by the literature considering the characteristics of global citizenship. Additionally, it was concluded that the variables determined by conflict resolution situations predict global citizenship perceptions. While the results of this study coincided with the results of some similar studies in the literature, they did not comply with the results of others. It can be stated that this situation may be due to the differences in the measurement tools used, the samples studied, and the studied regions. In this context, the following recommendations can be made:

• Good, resorting to reconciliation among their conflict resolution skills was very good, and resorting to violence was moderate. In order to maximize the knowledge, skills, and values of students regarding global citizenship, related activities can be organized in classes. It is seen that conflict resolution skills are not among the skills that are taught in the curriculum. For this reason, activities can be carried out in classes, to minimize the use of violence by students in resolving their conflicts in particular, and conflict resolution skills can be directly included in the curriculum.

• In the study, it was determined that female students had higher perceptions of global citizenship. Accordingly, this issue can be further investigated with male students, and studies in this regard can be conducted about their perceptions of global citizenship.

• This study was carried out with primary school students. Therefore, similar studies can be repeated at different stages of education. This is because students at different levels of education have different levels of development. These levels may affect their points of view.

• In this study, the relationship between global citizenship perceptions and conflict resolution skills was discussed. Therefore, other variables that could predict global citizenship perceptions can be examined in future studies.

AUTHOR CONTRIBUTIONS

The authors contributed equally to the article.

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Influential Factors on Mathematical Literacy of Turkish Students: An Educational Data Mining Study Using PISA 2015 Data

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Abstract

This study aims to classify students as successful and unsuccessful regarding mathematical literacy on Programme for International Student Assessment (PISA) 2015 database through data mining methods. The sample consists of all Turkish students who participated in PISA 2015. While data mining methods such as Support Vector Machine, Multi-Layer Perceptron, and J48 were used in data analysis, the data set was evaluated with 10-fold Cross-validation. The evaluation criteria included F-measure, Precision, Recall, Matthews Correlation Coefficient, and Receiver Operating Characteristic (ROC). In the classification of successful and unsuccessful students, analyses were conducted with 13 statistically significant variables according to Chi-SquareAttributedEval, GainRatioAttributeEval, and InfoGainAttributeEval methods. The results showed that the most important variables for classifying successful and unsuccessful students were learning time per week in total, and father's education level. The highest ROC value was 0.720. When comparing the precision values, the lowest classification value for the Multilayer Perceptron method was 0.645. There was no single method that performed best for all criteria. Researchers should use at least two methods to obtain more accurate results.

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INTRODUCTION

In today's rapidly changing and competitive business environment, prompt decisions must be made by the companies to ensure high productivity. Dealing with big data comprises of one of the problems of industry 4.0 and society 5.0. Data is collected to suggest predictive production in the world of the future with machines. It requires the use of advanced forecasting tools to systematically explain uncertainties and thereby transform data into information capable of making "informed" decisions (Lee, Kao, & Yang, 2014). Tremendous amounts of data are collected by modern computer systems from various sources, such as government statistics, credit card transactions, cash withdrawal machines at the bank, and Earth observation satellites with an unceasingly increasing volume of information available from the internet (Bramer, 2013; Hand, Manila, & Smyth, 2001). The amount of data is big, but it is not likely to make sense of these data entirely these days. "The world is becoming data rich but knowledge poor'' has deservedly been noted (Bramer, 2013, pp.1-2).

In science, engineering, and many disciplines were basically changed by the quick progress of knowledge and computer technology for twenty years. Currently, data-poor era has now been changed by the data-rich era, and new methods to conduct research is needed for the development of the data-intensive era. It is an essential task to develop robust data mining tools to analyze such data (Han & Gao, 2008). One of the changing disciplines in the data-rich period is education. Today, a lot of data about education is collected. These data are analyzed by methods such as machine learning or data mining. Machine learning or data mining is a technology that determines which factors are taken into account in successful decisions based on experience. It is a flourishing new way for mining knowledge from data (Witten & Frank, 2005). Data mining is the method of exploring patterns in data (Witten & Frank, 2005). It is an interdisciplinary analysis. Database technology, statistics, artificial intelligence, pattern recognition, and visualization, machine learning, all play a role. People at the scientific, business and the physical world, or at some other conceptual domain aim at discovering the relationships that exist in the real world (Hand et al., 2001).

People have become increasingly interested in big data in education (Siemens & Baker, 2012). Consistent with this interest, the number of educational data mining (EDM) studies has grown outstandingly in the literature over the last few years (Bousbia & Belamri, 2014). EDM is the sphere of using data mining techniques in educational environments to address important educational questions (Bakhshinategh, Zaiane, El Atia, & Ipperciel, 2018; Bousbia & Belamri, 2014; Romero & Ventura, 2010, 2013). EDM research has been preferred by researchers in recent years as a more effective alternative to classical inferential and multivariate statistics (Martínez-Abad, 2019). Many studies on educational data mining have been conducted so far for different purposes (Aldowah, Al-Samarraie, & Fauzy, 2019; Baker & Yacef, 2009; Bakhshinategh et al., 2018; Romero & Ventura, 2007, 2010). For instance, Bakhshinategh, Zaiane, El Atia, and Ipperciel (2018, p. 541) defined five goals of EDM research: "(1) student modeling (predicting student performance, achievement of learning outcomes or characteristics, detecting undesirable student behaviors, profiling and grouping students, social network analysis), (2) decision support systems, (3) adaptive systems, (4) evaluation, and (5) the scientific inquiry". Baker and Yacef (2009, pp. 6-7) addressed the four key applications of EDM method as (1) "improvement of student models", (2) "discovering or improving models of a domain's knowledge structure", (3) "studying pedagogical support" and (4) "looking for empirical evidence to refine and extend educational theories, and well-known educational phenomena". Romero and Ventura (2007, p. 135) stated that EDM can be applied within the scope of statistics and visualization, text mining, classification and outlier detection, clustering, association rule mining and pattern mining to improve the quality of education. Romero and Ventura (2010, p. 602) stated that the stakeholders of EDM are "students" (to personalize e-learning, etc.), "educators" (for purposes such as obtaining objective feedback about education and predicting student performance etc.), "course developers" (to maintain and evaluate course, etc.), "organizations" (to improve decision processes, etc.) and

"administrators" (to organize organizational resources in the best way, etc.). When the literature was examined, it has been seen that data mining provides feedback to diverse stakeholders for various purposes in education.

Data mining has facilitated educational research by providing information about learning time, better understanding learning, and improving education. Such researches have been conducted in various fields (including education, statistics, computer science, etc.) in the last few years (Romero, Ventura, Pechenizkiy, & Baker, 2010). Since EDM is an interdisciplinary field, this method is used in the areas such as education, machine learning, statistics, psychometry, information retrieval, recommendation systems, cognitive psychology, psycho-pedagogy, etc. (Bousbia & Belamri, 2014). We can use educational data mining for social science research that improves our understanding of the learning process. It is also valid for the applied research that improves the quality of learning (Bakhshinategh et al., 2018).

In the field of education, data mining is often used for the purpose of classification, one of the aims of data mining (Aldowah et al., 2019; Bramer, 2013). In this method, an object is put into categories or classes (Hämäläinen & Vinni, 2010). That is, it is the process of supervised learning that separates data into dissimilar predefined classes (Aldowah et al., 2019). There are a lot of examples of classification studies in education (e.g.; Aksu, 2018; Aksu & Güzeller, 2016; Bezek Güre, Kayri, & Erdoğan, 2020; Bresfelean, Bresfelean, Ghisoiu, & Comes, 2008; Bunkar, Singh, Pandya, & Bunkar, 2012; Büyükkıdık, Bakırarar, & Bulut, 2018; Costa, Fonseca, Santana, de Araújo, & Rego, 2017; Bezek Güre et al., 2020; Kaur, Singh, & Josan, 2015; Kılıç Depren, Aşkın, & Öz, 2017; Koyuncu & Gelbal, 2020; Liu & Whitford, 2011; Martínez-Abad, 2019; Martínez-Abad et al., 2020; Ramesh, Parkavi, & Ramar, 2013; Saarela, Yener, Zaki, & Kärkkäinen, 2016; Yukselturk, Ozekes, & Kılıç Türel, 2014). For instance, classifying a student project can be desired as pass or fail in education (Bramer, 2013). Estimating student achievement, performance, knowledge, detecting undesirable student behaviors in online courses/e-learning, estimating/preventing student dropout can be realized with the concepts of classification (Aldowah et al., 2019). Students are always classified by their instructors and teachers on their behavior, motivation, and knowledge in education. Assessing exam answers is also a classification task, where a score is determined by clear evaluation criteria (Hämäläinen & Vinni, 2010). Programme for International Student Assessment (PISA) is one of the first data sets that comes to mind when big data is mentioned in education, it is important to categorize or classify students in terms of their success in PISA. In addition, examining the variables that affect the success of students will contribute to the literature. At this point, data mining methods can be used in PISA dataset.

VARIABLES RELATED TO MATHEMATICAL LITERACY

For accountability in education, countries participate in international assessments like PISA, Progress in International Reading Literacy Study (PIRLS), Trends in International Mathematics and Science Study (TIMSS), Teaching and Learning International Survey (TALIS), etc. as well as national examination practices. "The Organisation for Economic Co-operation and Development's" (OECD) "Program for International Student Assessment (PISA)" is one of the sources that provide researchers with big data in education through collecting international data. PISA 2015 covered science, mathematics, reading, financial literacy, and collaborative problem solving with a primary focus on science, which was conducted in 72 countries and economies (OECD, 2017a). Mathematical literacy was assessed as one of the domains in PISA 2015 (OECD, 2017b).

OECD (2017b, p. 67) defined mathematical literacy as follows:

> Mathematical literacy is an individual's capacity to formulate, employ and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognize the role that mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective citizens.

Approximately 540 000 students from 72 countries participated in the PISA 2015 and provided some feedback to researchers and officials about the quality of education. It is possible to make inferences from the data collected through national, and international exams for accountability in education. In the selected sample representing 29 million 15-year-old students, PISA 2015 provides some data about mathematics, science and reading literacy with a lot of questionnaires and various cognitive indicators (OECD, 2016). It is necessary to analyze this big data and make inferences for accountability.

Although mathematical literacy and mathematics achievement are not exactly the same two concepts, since both concepts are related to student performance, it was seen that they were discussed together in the literature (e.g., D'Agostino et al., 2022; Keller, Preckel, Eccles, & Brunner, 2022). The studies have demonstrated that there is a relationship between mathematical literacy or achievement and variables like students' grade level (Ammermüller, 2004; Bratti, Checchi, & Filippin 2011; Fuchs & Wößmann, 2008; Gamazo & Martínez-Abad, 2020; Gilleece, Cosgrove, & Sofroniou, 2010), gender (Bratti et al., 2011; Else-Quest, Hyde, & Linn, 2010; Fuchs & Wößmann, 2008; Gamazo & Martínez-Abad, 2020; Gilleece et al., 2010; Hyde et al., 1990; Liu & Wilson, 2009; Keller et al., 2022; Reilly, Neumann, & Andrews, 2017), parental support (Hertel & Jude, 2016), test anxiety (Culler & Holohan, 1980; Cassady & Johnson, 2002; D'Agostino, Schirripa Spagnolo, & Salvati, 2022), achievement motivation (Gamazo & Martínez-Abad, 2020; Gunderson, Park, Maloney, Beilock, & Levine, 2018; Keller et al., 2022; Singh, Granville, & Dika, 2002), enjoy cooperation (Bratti et al., 2011; Slavin, 1983), sense of belonging school (Linnakylä & Malin, 2008; Wilms, 2003), learning time in mathematics, class periods, out of school study time in mathematics (Lee & Stankov, 2018; Singh et al., 2002), mother's education, father's education, highest education of parents (Anıl, 2009; Bezek Güre et al., 2020; Bratti et al., 2011; Chevalier & Lanot, 2002; Fuchs & Wößmann, 2008; Kılıç Depren et al., 2017; Liu & Whitford, 2011; Põder, Lauri, Ivaniushina, & Alexandrov, 2016; Ramesh et al., 2013; Yayan & Berberoglu, 2004).

Specifically, the studies reveal that as the grade level increases, mathematics literacy increases (Ammermüller, 2004; Fuchs & Wößmann, 2008; Gamazo & Martínez-Abad, 2020; Gilleece et al., 2010). Exploring gender differences in achievement using international measures such as PISA is a critical starting point for psychological and educational research, policies, and practices in Science, Technology, Engineering, Mathematics (STEM) that target women's underrepresentation (Keller et al., 2022). It can be claimed that gender differences in mathematics achievement continue today. While several studies indicate that females outperform their male peers in mathematics (e.g., Hyde, Fennema, & Lamon, 1990), there are also studies that show that males perform higher than females in mathematics (e.g., Liu & Wilson, 2009). Some studies found no difference by gender (e.g., Hyde, 2005) or statistically insignificant differences (e.g., Else-Quest et al., 2010). Ma (1999) examined the influence of anxiety on mathematics achievement and noted a negative significant relationship between mathematics achievement and anxiety at the elementary and secondary school level, which did not change for gender, ethnic group, scale used for measuring anxiety, grade level, and time of publication) in the meta-analysis study. This finding is supported by a lot of studies in the literature (e.g., D'Agostino et al., 2022; Gunderson et al., 2018; Hembree, 1990; Sherman & Wither, 2003; Tocci & Engelhard, 1991; Wu, Willcutt, Escovar, & Menon, 2014; Zhang, Zhao, & Kong, 2019). Studies have reported that individuals with high test anxiety perform less than individuals with low test anxiety in mathematics (e.g., Culler & Holohan, 1980; Cassady & Johnson, 2002; D'Agostino et al., 2022; Wine, 1971). Gunderson et al. (2018) revealed the relationships between motivational frameworks, math anxiety, and math achievement at the early elementary school level. As the motivation for success increases, the level of mathematics literacy also increases (Gunderson et al., 2018; Singh et al., 2002). In elementary and secondary schools, rewards and collaborative learning are required to increase student achievement (Slavin, 1983). Apart from this, variables of learning time in mathematics class periods and out-of-school study time in mathematics also affect mathematics literacy success. As the

education level of the parents increases, the mathematical literacy level of the children increases (Anıl, 2009; Bratti et al., 2011; Chevalier & Lanot, 2002; Fuchs & Wößmann, 2008; Kılıç Depren et al., 2017; Liu & Whitford, 2011; Põder et al., 2016; Ramesh et al., 2013; Yayan & Berberoglu, 2004).

CURRENT STUDY

There are many studies in the field of mathematics literacy or achievement. Similarly, examples of the use of educational data mining for classification are prevalent in the literature (e.g. Aksu, 2018; Aksu & Güzeller, 2016; Bezek Güre et al., 2020; Bresfelean et al., 2008; Bunkar et al., 2012; Büyükkıdık et al., 2018; Costa et al., 2017; Bezek Güre et al., 2020; Kaur et al., 2015; Kılıç Depren et al., 2017; Koyuncu & Gelbal, 2020; Liu & Whitford, 2011; Martínez-Abad, 2019; Martínez-Abad, Gamazo, & Rodríguez-Conde, 2020; Ramesh et al., 2013; Saarela et al., 2016; Yukselturk et al., 2014). Nonetheless, there are limited number of studies that compares the results of PISA dataset via different data mining methods (e.g., Aksu, 2018; Aksu & Güzeller, 2016; Bezek Güre, Kayri, & Erdoğan, 2020; Büyükkıdık et al., 2018; Liu & Whitford, 2011; Martínez-Abad, 2019; Martínez-Abad et al., 2020; Koyuncu & Gelbal, 2020; Saarela et al., 2016). When all these studies were examined, no completely similar study was found comparing the Multilayer Perceptron, J48, Support Vector Machine, and Naïve Bayes methods. Additionally, studies in the literature didn't discuss the significance of the variables affected mathematical literacy in detail using the PISA 2015 dataset. This is another reason for us to conduct the research. In this study, both the importance of variable and the performance of data mining methods in the classification of mathematics literacy were compared under different criteria. In this respect, the current research is thought to contribute to the literature.

For this aim, the following research questions were asked in the study:

(1) Which variables related to mathematical literacy are important for classifying students?

(2) How are the descriptive statistics on the important variables for successful and unsuccessful students?

(3) Based on the five evaluation criteria (F-measure, Precision, Recall, Matthews Correlation Coefficient (MCC) and ROC), which data mining method (Multilayer Perceptron, J48, Support Vector Machine, and Naïve Bayes) performs best in classifying students successful or not in mathematical literacy?

METHOD

RESEARCH TYPE

Since the research includes the classification of PISA mathematical literacy using different data mining methods, it was descriptive research (Fraenkel, Wallen, & Hyun, 2012).

SAMPLE

This study is based on PISA 2015 data for Turkey. A total of 5895 students from 61 provinces and 187 schools were involved in this exam to assess their proficiency in applying skills and knowledge to authentic problems and noncognitive responses. PISA is an age-based assessment, measuring 15-year-old students who are mostly at the end of compulsory education in grade 7 or higher.

The 15-year-old student population in PISA 2015 is defined as 1324089 in Turkey, while the reached universe in Turkey is defined as 925366 students eligible to participate in the application. School in PISA research sampling is determined by stratified random sampling method (Taş, Arıcı, Ozarkan, & Özgürlük, 2016, p. 5). A total of 5895 students' data in Turkey from 61 provinces and 187 schools were analyzed in this research. The sample of the study consists of all Turkish students who participated in PISA 2015.

DATA COLLECTION INSTRUMENTS

The independent variables used in data analysis in the present study were demonstrated at Table 1 and Table 2. The dependent variable in this study was mathematical literacy. When the educational data mining studies in the literature were examined, it was seen that the analyzes were carried out by considering the only plausible values as the dependent variable (Aksu, 2018; Aksu & Güzeller, 2016; Bezek Güre et al., 2020; Büyükkıdık et al., 2018; Gamazo & Martínez-Abad, 2020; Kılıç Depren et al., 2017; Koyuncu & Gelbal, 2020). Students were seen as successful and unsuccessful taken into account in research classify according to the average score of Turkey like similar studies (Aksu, 2008; Aksu & Güzeller, 2016; Büyükkıdık et al., 2018; Koyuncu & Gelbal, 2020). Plausible values were used for indicators of mathematical literacy. In the study, the average mathematical literacy score was obtained by taking the average of PVMATH coded math scores from PISA 2015 Turkey data. Then, the average of the achievement scores ($\bar{x}$ = 420) was taken and this value was determined as cut-off score. Although the mathematics literacy chosen as a dependent variable was a continuous variable as a score (PVMATH), this variable was converted into a categorical variable by comparing the PISA 2015 Turkey average score with 420 points.

In data mining research using WEKA software, several effective feature selection methods were used to achieve the best classification and prediction for performance (Kılıç Depren et al., 2017). Three of these methods are InfoGainAttributeEval, GainRatioAttributeEval, and Chi-SquaredAttributedEval. Since there were too many variables related to mathematics literacy in the PISA 2015 dataset, the importance of variables was examined by using the methods of InfoGainAttributeEval, GainRatioAttributeEval, and Chi-SquaredAttributedEval, and the variables which were determined insignificant or less important by the three methods were excluded from the dataset. A total of 14 variables (13 independent variables and 1 dependent variable) remained in the data set. These variables were students' grade level (ST001D01T, grade), gender (ST004D01T, gender), parental support (ST123, EMOSUPS), test anxiety (ST118, ANXTEST), achievement motivation (ST119, MOTIVAT), enjoy cooperation (ST082, COOPERATE), sense of belonging school (ST034, BELONG), learning time in mathematics (ST059Q02TA, MMINS), learning time per week in total (ST060Q01NA, TMINS), out of school study time in mathematics (ST071Q02NA, OUTHOURS), mother's education (MISCED), father's education (FISCED), highest education of parents (HISCED) and mathematical literacy (PVMATH, MATH). Detailed information about the percentages of the significance of variables according to the dependent variable mathematical literacy (Math) was given (see Figure 1).

All measurements of PISA 2015 questionnaires in this research were reliable since all McDonald's ω coefficients were above 0.70. The lowest coefficient was 0.704 for the enjoy cooperation questionnaire and the highest coefficient was 0.860 for the parental support questionnaire for the Turkey sample.

In addition, "Ethics Committee Permission" was also obtained for the research. Ethics Committee Permission was granted by Sinop University Ethics Committee with the decision number 2022/026 at the Ethics Committee meeting on 24/03/2022.

DATA ANALYSIS

Before starting data analysis, missing data were imputed. The data were analyzed by using WEKA 3.8.6 and SPSS programs. The mean ± standard deviation and median (minimum-maximum) for quantitative variables and the number of students (percentage) were used for qualitative variables. Multilayer Perceptron, J48, Support Vector Machine, and Naïve Bayes which are the classification methods in the WEKA program were used. The model evaluation criteria used in this research were explained in the next section.

MODEL EVALUATION CRITERIA

The data set was evaluated by using the 10-fold Cross Validation test option. Recall, Precision, F-measure, and Matthews Correlation Coefficient (MCC) were used as evaluation criteria. Computations of these measures were calculated with 2 x 2 contingency table including all possible outcomes (false positive (FP), and false negative (FN), true positive (TP), true negative (TN) classifications). All measures are computed as follows:

$$\text{Recall}=\frac{\text{TP}}{\text{TP+FN}} \quad (1)$$

$$\text{Precision}=\frac{\text{TP}}{\text{TP+FP}} \quad (2)$$

$$\text{F-measure}=\frac{2\text{xRecallxPrecision}}{\text{Recall+Precision}} \quad (3)$$

$$\text{Matthews Correlation Coefficient}=\frac{\text{TP x TN}-\text{FP x FN}}{\sqrt{(TP+FP)(TP+FN)(TN+FP)(TN+FN)}} \quad (4)$$

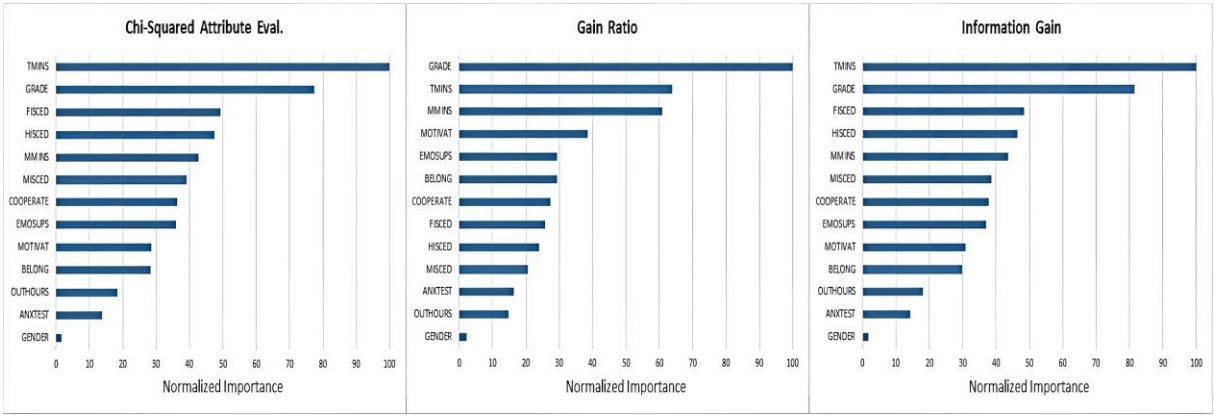
F- measure, Precision, Recall measures range from 0 to 1; the higher the value of these criteria have the better fit. Using the elements in the confusion matrix, the Matthews correlation coefficient (MCC) takes values between -1 and 1. Positive MCCs are indicative of correct predictions, MCC being 1 is an indication of perfect prediction (Kılıç Depren et al., 2017).

FINDINGS

VARIABLE IMPORTANCE

Significant Variables Related to Mathematical Literacy in PISA 2015 In this section, findings related to the first sub-problem were found. The percentages of the significance of variables according to the dependent variable mathematical literacy (Math) were given (see Figure 1).

Figure 1. *Variable Importance for Classifying Mathematical Literacy in Data Set*



The importance of the independent variables selected in the data set in the classification of mathematical literacy was examined with InfoGainAttributeEval, GainRatioAttributeEval, and Chi-SquaredAttributedEval methods (see Figure 1). When the bar graph was examined, values related to the significance of the independent variables were seen. Considering all three criteria, TMINS (minutes of overall school instruction) can be considered as the most important variable. When the InfoGainAttributeEval, and Chi-SquaredAttributedEval criteria were used, the same variable significance order was found; whereas in the GainRatioAttributeEval criterion, it was partially differentiated. Based on all three criteria, gender was a significant variable in classifying mathematics literacy, but it was the least important variable when compared to other independent variables. The number of independent variables in the data set was reduced to thirteen based on InfoGainAttributeEval, GainRatioAttributeEval, and Chi-SquaredAttributedEval criteria.

DESCRIPTIVE STATISTICS

Table 1 shows the descriptive statistics of continuous variables in the classification of mathematical literacy.

Table 1. *Descriptive Statistics for Continuous Variables*

Variables	Mathematical Literacy			
	Unsuccessful		Successful	
	Mean±SD	Median (Min.-Max.)	Mean±SD	Median (Min.-Max.)
EMOSUPS	12.45±3.13	13.00 (4.00-16.00)	13.34±2.47	14.00 (4.00-16.00)
ANXTEST	14.04±3.77	14.00 (5.00-20.00)	13.68±3.47	14.00 (2.00-20.00)
MOTIVAT	16.31±3.61	17.00 (5.00-20.00)	17.25±2.69	18.00 (5.00-20.00)
COOPERATE	22.92±4.68	23.00 (8.00-32.00)	21.14±3.49	24.00 (6.00-32.00)
BELONG	14.86±2.94	15.00 (6.00-24.00)	15.22±2.13	15.00 (6.00-24.00)
MMINS	5.24±1.81	6.00 (0.00-15.00)	5.79±1.39	6.00 (0.00-15.00)
TMINS	38.24±8.25	40.00 (10.00-60.00)	39.51±5.57	40.00 (10.00-60.00)
OUTHOURS	6.48±5.32	6.00 (0.00-30.00)	6.28±4.83	6.00 (0.00-30.00)

Mean ± standard deviation, median and maximum and minimum values obtained from questionnaires used in the study for the groups with successful and unsuccessful mathematical literacy performance were displayed at Table 1. Regarding parental support, the mean ± standard deviation value for students classified as unsuccessful was 12.45 ± 3.13, while it was $\bar{X}$ = 13.34 ± 2.47 for students classified as successful. The median (min-max) value of the group classified as unsuccessful for the same scale was 13.00 (1.00-16.00), while the median (min-max) value for the group classified as successful was 14.00 (4.00-16.00). The maximum score that can be obtained from the four-category and four-item scale is 16 and the minimum score is 4.

Descriptive statistics of categorical variables in the classification of mathematics literacy were presented at Table 2.

Table 2. *Descriptive Statistics for Qualitative Variables*

Variables		Mathematical Literacy			
		Unsuccessful		Successful	
		Frequency	%	Frequency	%
Grade	Grade 7	16	0.5	0	0.0
	Grade 8	94	2.9	11	0.4
	Grade 9	951	29.3	322	12.2
	Grade 10	2077	64.0	2231	84.2
	Grade 11	103	3.2	83	3.1
	Grade 12	4	0.1	3	0.1
Gender	Female	1670	51.5	1268	47.8
	Male	1575	48.5	1382	52.2
MISCED	None	535	16.5	259	9.8
	ISCED 1	1149	35.4	1002	37.8
	ISCED 2	579	17.8	444	16.8
	ISCED 3A, ISCED 4	149	4.6	280	10.6
	ISCED 3B, C	298	9.2	155	5.8
	ISCED 5A, 6	205	6.3	277	10.5
	ISCED 5B	330	10.2	233	8.7
FISCED	None	205	6.3	134	5.1
	ISCED 1	1115	34.4	680	25.6
	ISCED 2	895	27.6	566	21.4
	ISCED 3A, ISCED 4	132	4.1	222	8.4
	ISCED 3B, C	223	6.9	233	8.7
	ISCED 5A, 6	276	8.4	484	18.3
	ISCED 5B	399	12.3	331	12.5
HISCED	None	114	3.5	85	3.2
	ISCED 1	903	27.7	578	21.8
	ISCED 2	834	25.7	505	19.1
	ISCED 3A, ISCED 4	203	6.3	323	12.2
	ISCED 3B, C	362	11.2	249	9.4
	ISCED 5A, 6	362	11.2	564	21.2
	ISCED 5B	467	14.4	346	13.1

When Table 2 was examined, the percentages and frequencies of the students classified as successful and unsuccessful were found for the categorical variables used in the research. For example, 1670 of the female students included in the study were classified as unsuccessful and 1268 of them were classified as successful. In addition, while 51.5% of unsuccessful students are female students, 47.8% of successful students are female students.

PERFORMANCES OF DATA MINING METHODS

In this section, findings related to the second sub-problem were found. F-measure, Precision, Recall, MCC, and ROC were used as evaluation criteria and the results of the dependent variable categories were given in the Table 3.

Table 3. *Results of The Classification Criteria for Multilayer Perceptron, J48, Support Vector Machine, and Naïve Bayes Methods Based on Dependent Variable Categories for the Data Set*

Methods	Math	Performance Criteria				
		Precision	Recall	F-measure	MCC	ROC
Multilayer Perceptron	Unsuccessful	0,676	0,685	0,680	0,283	0,701
	Successful	0,608	0,597	0,602	0,283	0,701
J48	Unsuccessful	0,689	0,714	0,701	0,321	0,661
	Successful	0,634	0,605	0,619	0,321	0,661
Support Vector Machine	Unsuccessful	0,686	0,724	0,704	0,320	0,659
	Successful	0,637	0,594	0,614	0,320	0,659
Naïve Bayes	Unsuccessful	0,744	0,543	0,628	0,318	0,720
	Successful	0,579	0,771	0,661	0,318	0,720

As shown in Table 3, the Support Vector Machine method yields the best results according to Recall and F-measure performance criteria for classifying unsuccessful students. Multilayer Perceptron method gave the worst results in the classification of successful students according to most of performance criteria. When Table 3 was examined, the values obtained according to F-measure, Precision and, Recall criteria were found between 0.543 and 0.771.

Similarly, the average of the general classification results independent of category are given (see Table 4) by taking Precision, Recall, F-measure, MCC and ROC as evaluation criteria. Table 4 shows the results of classification criteria for the data set related to the Multilayer Perceptron, J48, Support Vector Machine, and Naïve Bayes methods.

Table 4. *Results of Classification Criteria for Multilayer Perceptron, J48 and Support Vector Machine Methods*

Methods	Performance Criteria				
	Precision	Recall	F-measure	MCC	ROC
Multilayer Perceptron	0,645	0,646	0,645	0,283	0,701
J48	0,664	0,665	0,664	0,321	0,661
Support Vector Machine	0,664	0,665	0,664	0,320	0,659
Naïve Bayes	0,670	0,645	0,643	0,318	0,720

As shown in Table 4, the J48 method gave the best results according to the F-measure, Recall and MCC criteria. Multilayer Perceptron method performed worst according to Precision, F-measure, Recall and MCC criteria in classifying students. J48 and Support Vector Machine gave same results according to Precision, Recall and F-measure. Naïve Bayes had best performance according to Precision and ROC criteria. When Table 4 was examined, the values obtained according to F-measure, Precision and Recall criteria were found between 0.643 and 0.720. All these values indicate that the correct classification rate of mathematics literacy of the selected independent variables was acceptable.

DISCUSSION, CONCLUSION AND IMPLICATIONS

There are many variables that affect mathematics achievement. Although mathematical literacy was one of the domains in PISA 2015, there were a lot of variables about it. All variables related to mathematical literacy were used at the beginning of the study. The variables in the data set were reduced to 13 variables (except the mathematical literacy dependent variable) by using the GainRatioAttributeEval, InfoGainAttributeEval, and Chi-SquareAttributedEval methods. The results mainly show that thirteen independent variables were important for classifying successful students in PISA 2015 using these three methods.

After selecting fourteen variables (students' gender, grade level, parental support questionnaire, test anxiety, achievement motivation questionnaire, enjoy cooperation questionnaire, sense of belonging school questionnaire, learning time in mathematics class periods, out of school

study time in mathematics, father's education, mother's education, highest education of parents and mathematical literacy), we compare continuous and categorical variables in terms of classifying students according to mathematics performance as successful or unsuccessful.

Gender was an important variable in terms of classifying successful students in PISA 2015 mathematical literacy in recent study. This result consistent with the previous literature. Gender was seen as one of the important variables affecting mathematical literacy (Else-Quest, Hyde, & Linn, 2010; Fuchs & Wößmann, 2008; Liu & Wilson, 2009; Hyde et al., 1990; Reilly et al., 2017). Different aged males surpassed females on many domestic and international mathematic assessments such as PISA, TIMSS, the National Assessment of Educational Progress (NAEP) and Scholastic Aptitude Test (SAT) (Liu & Wilson, 2009: p. 165). Hyde, Fennema and Lamon (1990) found those girls showed a slight superiority in their meta-analysis by using 100 studies' results. There was no big gender difference in the meta-analysis conducted by Else-Quest, Hyde, and Linn (2010) regarding two major international data sets, the 2003 PISA and the TIMSS, representing 493495 students aged 14-16, to estimate the size of gender differences in mathematics achievement across 69 nations, but male reported more positive mathematics attitudes than females. Gender differences play a role in mathematics achievement, in conjunction with self-efficacy beliefs, attitudes and other related factors (Reilly et al., 2017). When we investigated literature, the gender achievement gap has been declining since 1980 (Feingold, 1988), but gender difference in mathematics can not be ignorable (Hyde et al., 1990; Liu & Wilson, 2009). It is thought that gender differences in mathematical literacy are not based on biological origin. Socio-cultural factors may cause gender difference in success. Within the framework of inclusive education, the content of mathematics courses should be arranged in a way that attracts the attention of both genders. Necessary precautions for gender equality should be taken by policy makers.

Grade level was significantly associated with achievement in PISA mathematics test consistent with several research (Ammermüller, 2004; Fuchs & Wößmann, 2008; Gilleece et al., 2010). However, it should be noted that the sample of PISA 2015 Türkiye mostly consists of 10th grade students. Family background (MISCED, FISCED, HISCED in PISA) effect was important in the PISA and other studies (Anıl, 2009; Chevalier & Lanot, 2002; Fuchs & Wößmann, 2008; Põder et al., 2016, Yayan & Berberoglu, 2004). As parents' education level increased, success in each area of PISA 2000 increased (Fuchs & Wößmann, 2008).

Similar to our study, Ramesh, Parkavi and Ramar (2013) found that parents' education was an important variable in predicting student performances using data mining methods. Kılıç Depren, Aşkın, and Öz (2017) found that parents' highest education level was important factor in mathematic achievement in their EDM research with using TIMSS 2011 data. HISCED found as important variable for reaching science proficiency in another EDM research with using PISA 2006 US national sample (Liu & Whitford, 2011). Mother's education level (MISCED) and father's education level (FISCED) were significant variables in Bezek Güre, Kayri, and Erdoğan's (2020) recent EDM study. Parallel with the researches in the literature, one of the most important variables was found the educational level of the parents in our research. It is thought that the increase in the education level of the parents may cause an increase in the awareness of raising children. The education level of the society should increase so that educated individuals can be raised in the next generation. It is also found that as the education level of the parents increases, the success in education will increase.

In our study, the mean and median scores of the students who were successful and unsuccessful taken from the anxiety questionnaire were found similar. However, anxiety appeared to be an important variable in classifying successful and unsuccessful students. As a result of research conducted in the literature for many years, a negative relationship was found between math anxiety and mathematics achievement (D'Agostino et al., 2022; Gunderson, Park, Maloney, Beilock, & Levine, 2018; Sherman & Wither, 2003; Wu et al., 2014; Tocci & Engelhard, 1991). Similarly, this finding was supported by meta-analysis studies (Hembree, 1990; Ma, 1999; Zhang et al., 2019). Generally, high math anxiety causes low math success. Aksu and Güzeller (2016) found the anxiety was an important

variable in classifying students in terms of mathematics achievement in their research using PISA 2012 data. D'Agostino et al. (2022) supported these results in their research which showed a negative association between anxiety and academic achievement using PISA 2015.

Motivation was another variable affecting success consistent with our research (Gunderson et al., 2018; Singh et al., 2002). Keller et al. (2022) emphasized the importance of achievement motivation in their study with top-performing math students in 82 countries using PISA data. Singh et al. (2002) found that motivation and academic time had positive effects on mathematics and science achievement in their research. Learning time in mathematics (ST059Q02TA, MMINS), learning time per week in total (ST060Q01NA, TMINS), out of school study time in mathematics (ST071Q02NA, OUTHOURS) were found important variables in this research. Particularly academic time spent on homework had the strongest impact on achievement in established structural equation modeling in the other research (Singh, Granville, & Dika, 2002). Students should be motivated to learn mathematics and high anxiety situations should be eliminated in education.

Lee and Stankov (2018) aimed to identify non-cognitive constructs that best predict students' mathematics achievement in PISA based on 43 variables. There were common variables like test anxiety (ST118, ANXTEST), learning time in mathematics (ST059Q02TA, MMINS), learning time per week in total (ST060Q01NA, TMINS), out of school study time (ST071Q02NA, OUTHOURS), highest education of parents (HISCED), etc. with our study among these variables.

As the level of belonging to school decreases, it is often associated with low success; but some studies have found no association (Wilms, 2003). In PISA 2003, Finnish students have the lowest sense of belonging to school in Nordic countries, while students' attitude and cognitive performance towards school are quite high (Linnakylä & Malin, 2008). There are different findings in the literature on belonging to school affects success.

Enjoy cooperation is also an important variable in our research. Bratti, Checchi, and Filippin (2011) investigated the impact of collaborative and competitive attitudes on mathematics literacy success using PISA 2003 data. While individual competitive attitudes are positively correlated with test scores, individual collaborative attitudes correlate negatively with test scores. When this situation is handled with peer attitudes, the situation is reversed. Grade, gender, and highest education of parents (HISCED) were taken into consideration in this research like in our research. Masci, Johnes, and Agasisti (2018) tried to find the factors affecting the PISA 2015 mathematics achievement of nine countries by applying machine learning with a two-step methodology. They revealed that the most influential variables affecting mathematics achievement in their research are gender, parental education, motivation, anxiety, and socioeconomic index. It was also another variable that they took into account the enjoy cooperation in their research. Similarly, Slavin (1983) found that collaborative learning is an effective factor in student achievement. The ability to cooperate, which is among the 21st century skills, should be encouraged in students' educational environments.

Hertel and Jude (2016) considered parents as strong stakeholders in education and emphasized that parental support is an important variable in student motivation and success (such as separating high- and low-performing students). In our study, another important variable appears as perceived parental support. EDM methods carried out in this study only identify the classification of mathematical literacy with important variables; these variables do not put forward any temporal relations or causality.

Our research has two dimensions: determining the variables affecting success in mathematical literacy and comparing data mining methods. Data mining techniques were used to classify students as successful and unsuccessful according to their mathematical literacy in this research. Comparison of data mining methods (Multilayer Perceptron, J48, Support Vector Machine, Naïve Bayes) with F-measure, Precision, Recall, MCC, and ROC performance criteria was conducted. With the variables used in this study, the performances obtained from Multilayer Perceptron, J48, Support Vector

Machine and Naïve Bayes methods according to five criteria were found above 0.64. All three methods classified the successful or unsuccessful students in terms of mathematics literacy sufficiently. When the dataset was analyzed with 10-fold Cross Validation option, there is no method gave the best results in terms of all criteria in this research. There is no study comparing these four methods with various criteria in education. However, in addition to these methods, there was a study (Firdausi, Erwin, & Nugroho, 2010) comparing the performances of k-Nearest Neighbors (kNN), Naïve Bayes methods according to recall, precision and accuracy criteria in behavior-based malware detection. In the Firdausi, Erwin, and Nugroho (2010)'s study, J48 showed the best performance according to all three criteria. When the comparisons of data mining methods in education were examined, different results were obtained on different data sets. Ramesh, Parkavi, and Ramar (2013) found that the Multilayer Perception method was more appropriate than the Naïve Bayes, Sequential minimal optimization (SMO), J48, and REPTREE methods when considering the accuracy value for predicting students' achievement with 500 records. Yukselturk et al. (2014) compared four classification algorithms (k-Nearest Neighbor (k-NN), Naïve Bayes (NB), Decision Tree (DT), and Neural Networks (NN)) using 10-fold cross-validation technique for predicting 189 dropout students. Yukselturk et al. (2014) trained and tested the data set using the 10-fold cross validation method, similar to our research, and found the performance of decision trees according to the accuracy criterion as 79.7%. Decision tree methods were found more sensitive than others in their study. In Kaur, Singh, and Josan (2015)'s study conducted on 152 students, they classified student performance using Multilayer Perception, Naïve Bayes, SMO, J48 and REPTree algorithms. Multilayer Perception performed best in small sample according to accuracy, and F-measure. Costa et al. (2017) found that their data mining techniques (Decision Tree via J48, Support Vector Machine, Neural Network, and Naïve Bayes) were sufficiently cultivated for identifying students' academic failures early. Generally, the J48 and Support Vector Machine showed the best performance. Kılıç Depren, Aşkın, and Öz (2017) classified mathematical success with using TIMSS 2011 8th Grade Turkey sample's data considering 11 variables based on "two Decision Tree algorithms (Random Forests and J48), a Bayesian Network Algorithm (Naïve Bayes), an Artificial Neural-Networks algorithm (Multilayer Perceptron), and the Logistic Regression" and found that Logistic Regression performed the best. In the study of Kılıç Depren, Aşkın, and Öz (2017), multilayer perceptron algorithms and J48 performed similarly to our research according to precision and f-measure criteria (≈ 0.77). In terms of MCC (≈0.48), it is seen that the results of both methods are in line with our study of Kılıç Depren et al. (2017). Bezek Güre, Kayri, and Erdoğan (2020) found that Random Forest performed better than Multilayer Perceptron with PISA 2015 mathematical literacy data. Koyuncu and Gelbal (2020) tested the performances of K-Nearest Neighborhood, Naïve Bayes, Logistic Regression, and Neural Networks analyzes at different sample sizes using PISA 2012 data. They found that Naïve Bayes performed well even with small sample size. All of these results show that there is no single best method for EDM in all conditions.

Multilayer Perceptron, J48, Support Vector Machine, and Naïve Bayes methods were used in this research. Researchers can perform similar research using at least two data mining methods. The other data mining methods and other criteria can be used in future EDM studies by using other large-scale assessments or other educational data. A limitation of our research is a sample size. Therefore, comparing the performance of EDM methods can be handled with a bigger sample. Future research may replicate the analysis on other countries' PISA data. Comparative studies can be conducted with data from other countries. As a result of the research, 13 independent variables affecting student performance in mathematical literacy were discussed. Similar studies can be carried out by revealing the variables that affect mathematics achievement through other data sets.

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