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Osmangazi Journal of Educational Research (OJER) is published by the Institute of Education of Eskisehir Osmangazi University, Türkiye.

OJER is an online, open-access, international, scholarly, peer-reviewed journal offering scholarly research articles on various topics in all areas of educational sciences.

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"Education is a lifelong journey and life's greatest gift."

(Albert Einstein)

Dear Readers,

In the past year, many events, scientific meetings and studies were conducted in the 100th anniversary of our Republic. Great Leader Atatürk's maxim "Civilized ideas and modern advances must spread and develop within our country without losing a moment. For this reason, all scholars and scientists should consider it a duty of honor to work on this subject." is an important message to us researchers. Realizing this importance, it is a necessity for educational researchers to conduct more and better research that will contribute to science and education, has international readability, and has a high widespread impact. H. Spencer says that the main purpose of education is not to be informed but to take action. As a very proud development for our country, Turkey's first astronaut Alper Gezeravcı arrived safely at the International Space Station to conduct 13 different scientific experiments which were determined by universities and research institutions, and started his historic mission with Atatürk's message "The future is in the skies." This development is a very important, historical move for our country.

In our country, as in the rest of the world, science is becoming increasingly felt in every aspect of life, and the importance of conducting scientific studies is increasing. Great Leader Atatürk said in one of his maxims: "All progress is the work of human thought. Our first job should be to put the idea into action. It is enough for the nation to control itself and think once! Even if the nation thinks wrongly at first, she can correct this mistake after a while. "Once the idea is put into action, everything will gradually fall into order and get better." He emphasized the value of thinking with these words.

Humanity's journey in science is shaped by passion for research and curiosity for learning. Considering the historical development of science, it is seen that technological developments have evolved from the internet age to the artificial intelligence era. Artificial intelligence and productive artificial intelligence systems not only affect professional groups; it also affects teacher education. Similarly, there is a prevailing view that productive artificial intelligence systems will create significant changes in teacher education and reduce teachers' workload. With this accelerated change, it seems that every aspect of life and academia will be effected . Inspired by Goethe's saying "Knowing is not enough, we must apply. Wanting is not enough; we have to do." we as researchers should

include applied studies in our research and make it possible for the research results to be reflected in the field. Being a real researcher, in the words of Albert Szent Gyorgyi, means seeing what everyone has seen before and finding out what no one else has thought, and in L. Pasteur's words, luck smiles only on prepared ideas. Valuable ideas, planned research process and research that contributes to science; it is as valuable today as it was yesterday. Inspired by the words of Atatürk: "I have never known what pessimism was at any point in my life"... Be curious, research, think and always question... Stay with science...

With this motivation, **OJER (Osmangazi Journal of Educational Research)** is published twice a year in English by Eskişehir Osmangazi University Institute of Educational Sciences. It is an online, open accessed, international, peer-reviewed journal that offers scientific research articles in all fields of educational sciences. Qualitative and quantitative mixed method researches and compilation studies in many fields whose subject is education and training; research results from theory to practice are included. Our goal is to promote researches that are original, creative, enlightened and that shape the future with ethical values.

In this issue of **OJER**, there are important studies that will contribute to the field. We would like to express our gratitude to the researchers, the reviewer referees, the editorial board, the journal secretariat and our readers who contributed with their to improve our journal. In this issue of **OJER** of Fall 2023, 4 studies are presented, as introduced below:

The 1st article of this issue is entitled "The Relationship Between School Principals' Diversity Management Behaviors and Teachers' Job Performance" written by Tuba ÖGÜCÜ, and Ali İlker GÜMÜŞELİ. This research scrutinizes the relationship between teachers' perceptions of diversity management by school principals and teachers' job performances. The research sample comprised of 216 teachers who were working in a public middle school in Bakırköy, İstanbul. The research results showed that teachers' perceptions of diversity management by school principals were at "good" levels. Teachers' perceptions of their job performances were high in mean (x=4.41) in the "always" interval. Thus job performance of teachers can be interpreted as "very good". There was a moderately statistically significant positive relationship of 46.5% between school principals' diversity management and teachers' job performances. This suggests that teachers' job performance increases as school principals' diversity management grades increase. Also, school

principals' diversity management behaviors were found to affect teachers' job performances positively by 19.8%. Therefore school principals' diversity management could be a predictor of teachers' job performance.

The 2nd article of this issue is entitled "Examination of Seventh Grade Students' Van Hiele Geometric Thinking Levels and Their Mistakes on 'Quadrilaterals' " written by Sultan SATIR, and Aytaç KURTULUŞ. In this study, it was aimed to examine seventh grade students' Van Hiele geometric thinking levels and their mistakes on 'Quadrilaterals'. The research was conducted with ten seventh grade students and the case study design was used. According to the research findings, seventh grade students have misconceptions about diagonal, height concepts and special quadrilaterals. One of the most important of these is that the square positioned on one corner cannot be recognized by students at the analysis level, but is recognized by students at the visualization level. Students at the analysis and visualization levels have different misconceptions regarding the trapezoid. While there is a misconception that all side lengths must be different from each other as a condition for being a trapezoid, there is also a misconception that having four sides is sufficient. Another one is related to the concept of diagonal. There is a misconception that shapes with equal side lengths also have equal diagonal lengths. While no errors or misconceptions were encountered in students at the informal level, misconceptions were encountered in students at the analysis level, and more errors were encountered in students who were at visualization level and could not be assigned to any level.

The 3rd article of this issue is entitled "Investigation of Pre-service Middle School Mathematics Teachers Habits of Mind in Pattern Generalization Problems" written by İrem COŞKUN, Deniz ÖZEN-ÜNAL, and Ersen YAZICI. In this study, it was aimed to determine pre-service middle school mathematics teachers' habits of mind. The method of the study was determined as a case study. Participants were 23 junior pre-service middle school mathematics teachers. The results of the study show that similar habits of mind revealed by pre-service teachers in problem situations. The pre-service teachers had more difficulty in balancing exploration and reflection compared to the other. It was found that the pattern types of the problems affected the habits of mind. It is suggested that more studies need to be done to reveal and foster the quality of algebra and algebraic thinking.

The 4th article of this issue is entitled "Using Bingo Games in Teaching "Jobs" in English" written by Oğuzhan ÇINAR, Cavide DEMİRCİ, and Süheyla ORAN ÇINAR. Children learn more easily through playing games. For that reason, a teacher needs to use educational games to set an effective learning environment. In this study, it was aimed to get the opinions of primary school 4th grade students about teaching "jobs" subject using bingo game. Pre-test and post-test results of the students showed that the game had positively affected the learning of the students and students stated that they had a lot of fun while playing and learned while playing.

See you in the next issue, next year….

"Stay with Science, Stay with Us"

M. Zafer BALBAĞ, Ph.D.
Editor In Chief
Acting Director of Institute of Education
Eskişehir Osmangazi University, Türkiye

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The Relationship Between School Principals' Diversity Management Behaviors and Teachers' Job Performance

***Tugba Öğücü, **Ali İlker Gümüşeli**

Abstract. This research scrutinizes the relationship between teachers' perceptions of diversity management by school principals and teachers' job performances. For this research, a relational survey model was utilized. The sample comprised 216 teachers who work in public middle school Bakırköy, İstanbul. The data were collected from teachers based on a "Diversity Management Scale" and a "Teacher Job Performance Scale". Mean, correlation, and regression analysis were used for data analysis. Results showed that teachers' perceptions of diversity management by school principals were at "good" levels. Teachers' perceptions of their job performances were high in mean ($\bar{x}$=4.41) in the "always" interval. Thus job performance of teachers can be interpreted as "very good". There was a moderately statistically significant positive relationship of 46.5% between school principals' diversity management and teachers' job performances. This suggests that teachers' job performance increases as school principals' diversity management grades increase. Also, school principals' diversity management behaviors were found to affect teachers' job performances positively by 19.8%. Therefore school principals' diversity management could be a predictor of teachers' job performance.

Keywords: Diversity management, school principal, teacher, teacher job performance.

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In the globalizing world, and with the increase in social, economic, and political developments and the migration movements created by these, there have been significant alterations in the construction and demography of the population in many countries in recent years. These social and societal changes also affect other factors that constitute society (Kevser, 2019, p.87). The most important of these changes is the increasing prevalence of multicultural population structures. Developed countries such as the USA, Australia, Belgium, Canada, India, and the United Kingdom are considered multicultural countries and for these countries, workforce diversity is an important issue that informs global competition (Mujtaba & Mujtaba, 2011, p.70). The multicultural structure in Europe was formed after 1990 as a result of free movement and according to the EU constitution, the motto of the EU was "united in diversity" (Kevser, 2019, p.87). Turkey, on the other hand, has been a transit region for migration movements due to its geopolitical location and has become a country that receives migration due to civil wars and other factors in neighboring countries. It can be said that the population structure of Turkey has started to accommodate more diversity due to both global competition and migration.

Changes that come with globalization can add differences to organizational management and the workforce. In this context, the need for diversity management in organizations arises. Diversity can be an opportunity as it enriches life and nurtures creativity. On the other hand, intolerance of diversity also gives rise to conflicts that are difficult to manage. Therefore, effective diversity management is a great value for organizations. To this extent, the importance of diversity and its management emerge (Tozkoparan & Vatansever 2011, p.91). Organizations, where differences are welcomed, accepted and embraced, can have qualities such as understanding, openness, honesty, fearlessness, learning, responsibility, developed communication network, and avoidance of extrajudicial execution (as cited in Memduhoğlu, 2017, p.288).

The concept of diversity can be considered to have come to the fore in the field of management after the 1950s (Şahin & Karakuş, 2016, p.354). The concepts of equal employment, positive discrimination, and diversity management have been on the agenda for the last forty years. Diversity management is based on the political and philosophical debates created by the anti-discrimination actions that started in the USA in the 1960s (Polat & Arslan, 2020, p.245). The Civil Rights Act was signed in America in 1964 to prevent discrimination in the fields of education, housing, and employment due to differences such as racial, ethnic, and gender (Dobbin et al.2007, p.22). Diversity management has been evaluated as workforce diversity management after the 1980s (Şahin & Karakuş, 2016, p.354). Diversity management, which began to be implemented in the United States

after the 1980s, tries to find solutions by evaluating various problems created by individual differences at the level of individuals, organizations, and society (Polat & Arslan, 2020, p.245; Şahin & Karakuş, 2016, p.354). Diversity management, which is a managerial understanding, emerged after the actions against discrimination and attempts to create equal opportunities in workplaces in the USA and then spread all over the world (Polat & Arslan, 2020, p.245).

Bringing the concept of diversity and the management of diversity approach to the literature was carried out in the USA in the 1990s (as cited in Polat & Arslan, 2020, p. 245). According to Pitts (2009), R. Roosevelt Thomas, Jr. was one of the people who drew attention to the concept of diversity management. In 1990 he called on organizations to take advantage of diversity as a power and competitive advantage. However, he went beyond the discussion of difference as race and ethnicity and started to interrogate the idea of what difference means. He argued that managing diversities means managing demographic differences or all differences based on function (Pitts, 2009, p.329).

Diversity management is an approach that respects the similarities and diversities of persons and treats each employee fairly by bringing different workforces together, as well as a planned process to create and maintain an inclusive and positive work environment (Onsongo & Maina 2013, p.31; Singh, 2018, p.251). It is also a management philosophy that leads to an increase in performance and profit (Özbilgin, 2007 as cited in Bakaç et al., 2019, p.21). Diversity management approach requires knowing the importance of differences in all kinds of human relations, seeing differences as richness, and understanding differences as the dynamics of change and development (Memduhoğlu, 2017, p.263). Diversity management is concerned with seeing all members of the workforce as assets and is more accepting of differences among employees (Singh, 2018, p.256). As a matter of fact, Singh (2018) in his research exploring the relationship between the diversity management and acceptance of differences revealed that diversity management has a positive impact on the acceptance of differences.

The organizational benefits of managing diversity include increased competition and productivity, job satisfaction, creativity, employee retention and cohesion, synergy, and cost reduction. The disadvantages of not being able to manage diversity are communication problems and an increase in conflicts, deterioration of working order, and a decrease in commitment (Balay et al., 2014, p.234). While the organizational benefits of managing diversity may increase organizational performance, performance may decrease in cases where diversity cannot be managed. In this context, conflict may arise among employees and thus the stress of the employee may increase, motivation

may decrease and job satisfaction may decrease. In addition, the emergence of injustice, discrimination, and communication problems among employees can lead to insecurity, exclusion, unhappiness, and intention to leave the job. It was found in Inegbedion et al. (2020) that when employees perceived marginalization, disagreements and cultural differences at higher levels, then the application of diversity management in the organization was more successful. Also, when teamwork and diversity management were more competent, the organizations were more successful.

There are some problems that managers experience with employees with different characteristics. These problems are; discipline, performance, communication, teamwork, taking risks and initiatives, interpersonal conflict, feedback, and quality problems (Esty et al., 1995 as cited in Sürgevil, 2008, p.96). It can be said that these problems can turn into creativity, problem-solving, teamwork, high motivation, critical thinking, happiness, and satisfaction with effective diversity management.

The most important factor for organizations to maintain their activities and reach their goals is worker performance (Limon & Sezgin-Nartgün, 2020 p.565). Employees seek to achieve their goals based on an organizational standard. This means that "performance" can be defined as both the result of the task and by the method used to get that result (Salajeghe & Tanabandeh, 2016, p.452-453). With this definition of performance, an employee can expect different levels of success according to their personal attributes, role, and other conditions (p.452). This concept of job performance includes a different meaning from genereal the concept of performance. Job performance is "scalable actions, behavior and outcomes that employees engage in or bring about that are linked with and contribute to organizational goals'' (Viswesvaran & Ones 2000, p.216). Elements of job performance are employee relations, attitudes, employee turnover, creativity, and productivity grades (Lagat et al. 2019, p.66). According to Motowidlo et al. (1997), job performance is behavioral (conditions that cannot be controlled by the employee affect performance), episodic (the employee's inability to contribute to organizational goals), evaluative (behaviors show differences in terms of their contribution to organizational goals) and is multidimensional (p.72-75).

According to Risnah et al. (2022), teacher job performance is the performance of teachers while fulfilling their responsibilities, and how they perform the learning process and evaluate the learning outcomes (p.122). Teachers' job performance is not limited to teaching behavior in the classroom or school; it is wherever students are and it is multidimensional (as cited in Limon & Sezgin-Nartgün, 2020, p.567).

Bhat and Beri (2016) proposed a concept for developing and measuring job performance, building on earlier scholarship. It suggested a division between 1) Completing tasks to improve organizational performance (Task Performance), 2) Completing tasks where the main goal is not organizationa performance, (Contextual Performance) and 3) Actions made in response to new demands or changesin the environment (Adaptive Performance) (p.937). This paper will be using these three general divisions in evaluating teachers' perception grades.

Task Performance is based on the success of employees in meeting appointed standards (Altunova,2019, p.17). Contextual Performance can be a method of creating and maintaining psychological, social, and organizational environments (as cited in Limon & Sezgin-Nartgün, 2020, p.566). This is where behaviors centered around rule-following, caring about a job, volunteering, and institution loyalty shown by adopting institutional aims can be seen (Altunova, 2019, p.17). Adaptive Performance is where the employee shows their coping behaviors, and ability to learn new approaches and skills (as cited in Limon & Sezgin-Nartgün, 2020, p.566).

Some studies reveal the relationship between diversity management and job performance in organizations where differences are inevitable. When the literature is reviewed, the studies and their results are given below.

Pitts (2009) concluded that diversity management had a positive and strong relation with job performance. In their research in the communication sector, Makonyango and Bichanga (2015) concluded that there was a positive relationship between effective workplace diversity management and job performance. Kowo & Sariat (2018) show that diversity management practices are important for any organization and are positively associated with high employee performance. Yeşil and Purtaş (2018) concluded in their research in the textile industry that there was a positive relationship between management diversities, corporate reputation, and the performance of the business. In Kocuk (2019), it was found that diversity management applied in enterprises has a significant efficiency for employee productivity. Keceli et al. (2020) recorded empirical findings that support the positive impacts of diversity management on organizational and individual performance. In a literature review, Kevser (2019) showed that diversity management provided a positive effect (Etsy et al., 1995); the reason for decreased impact of minorities was the inability to manage diversity (Ensari, & Miller, 2006); the relationship between diversity management processes and performance was examined (Özkaya et al., 2008; Sürgevil & Budak, 2008). In Bayar (2021), it was found that management of individual differences had a negative impact on employee productivity.

The above studies can show how diversity management is reflected in organizational and individual performances. Accordingly, it can be said that diversity management in organizations has positive and negative impacts on job performance. There was no research found showing the relationship between diversity management in schools, which is one of the most important organizations, and teacher job performance.

The fact that demographic, social, cultural, and individual differences are natural and widespread makes it inevitable for individuals with different characteristics to work in the same environment. In this context, as in all organizations, schools are places where differences are experienced. Therefore, diversity management, which is important for all organizations, is also important for schools as educational organizations. According to Ergül and Kurtulmuş (2014), diversity management is more important in schools than in other organizations, since a school environment where differences are not accepted and people are excluded, has negative effects on students.

According to Çetin and Bostancı (2011), good management of schools with an approach that includes diversity management and respect for diversity will create a democratic environment in those schools. For this reason, school principals need to have some skills to foster an effective diversity management process. Diversity management skills for managers' could be listed as; being fair, integrative, mediator, tolerant, empathizing, and preserving values (Polat & Ölçüm, 2016, p.72). Effective use of these skills can increase the success of the school by increasing the performance of the teachers. As a matter of fact, in research (Harris & Sass, 2012) based on teacher performance evaluation, it was found that teachers who were evaluated by principals as having higher performance had higher success rates for their students. These skills can also form the basis of corporate culture with concepts such as an environment of trust, respect, tolerance, empathetic behavior, perception of justice, equality, inclusion and integration, merit and unconditional acceptance at school.

In schools where diversity is well managed, there will be no prejudices, discrimination, or exclusion. This will create a democratic environment free from anxiety and fear, high performance, and commitment to the school. In this context the main element of high performance at school is the teacher. As a matter of fact, high teacher job performance is the most important factor in terms of the quality of education. It is a significant factor when researching the grade of diversity management of school principals and its impact on teacher job performance and how it may increase the quality of

education. In this extent the main question of this research is to expose the impacts of school principals' grade of diversity management on teacher job performance.

In this research, with the emergence of the relationship between the management of diversity in schools and teacher job performance, there will be an opportunity for school principals to review their managerial practices and approaches to diversity. In addition, no research has been found that suggests a relationship between school principals' skill to manage diversities and teachers' job performance. Thus, it can be said that the results of this research will contribute to the literature.

Aim of the Research

The main aim of the research is to analyze the relationship between teachers' perceived diversity management of school principals and teachers' job performance accordingly. To this end, responses to the following questions were studied:

1. What is the grade of middle school teachers' perceived diversity management of school principals'?

2. What is the grade of middle school teachers' perceived job performances?

3. Is there any statistically significant relationship between school principals' diversity management behaviors and teachers' job performances, depending on teachers' perceptions?

Method

Research Model

The current search investigates the relationship between teachers' job performances and school principals' diversity management behaviors in 13 state middle schools in Bakırköy, Istanbul. In the search, a relational screening model is used.

Universe and Sample

The universe of the search consists of 493 teachers who work in middle schools in Bakırköy District of Istanbul Provincial in the 2021-2022 academic year. The sample consists of 216 teachers who were selected with simple random sampling technique. The research was held with a sample of 216 teachers which was applied with the help of the formula below. The formula is as follows (Özdamar, 2003 as cited in Demir, 2019, p.17):

$$n= \frac{N.t^2p.q}{d^2.(N-1)+t^2p.q} \qquad \frac{493(1,96)^2(0,5)(0,5)}{(0,05)^2(493-1)+(1,96)^2(0,5)(0,5)} = 216.16$$

Data Collection Tools

The data collection tool consists of two sections. In the first section, there is a "Teacher Job Performance Scale" and in the second section there is "Diversity Management Scale". Both scales are 5-point Likert scales. The scale scores were "1=Never", "2=Rarely", "3=Sometimes", "4=Mostly" and "5=Always" in the "Teacher Job Performance Scale" and "Diversity Management Scale". The mean scores and meanings that can be obtained from the Diversity Management Scale are given in Table 1 (Ergül & Kurtulmuş, 2014, p.306).

Table 1.

Mean scores from the Diversity Management Scale and the meanings

Interval	**Meaning**
1.00-1.80	Very bad
1.81-2.60	Bad
2.61-3.40	Partly good
3.41-4.20	Good
4.21-5.00	Very good

In the Teacher Job Performance Scale, it is seen that the scale results are distributed over a width of 4/5 points. The meanings of the score range of the Teacher Job Performance Scale are presented in Table 2.

Table 2.

Teacher Job Performance Scale score ranges and the meaning

Scores	**Interval**	**Meaning**
1	1.00-1.80	Never
2	1.81-2.60	Rarely
3	2.61-3.40	Sometimes
4	3.41-4.20	Mostly
5	4.21-5.00	Always

The Teacher Job Performance Scale was developed by Limon and Sezgin-Nartgün (2020). The scale consists of 37 items in total, including the task performance dimension with 16 items, contextual performance dimension with 9 items, and adaptive performance dimension with 12 items. The Cronbach's Alpha values are the reliability values of the scale. These values are .890 in the task performance dimension, .881 in the contextual performance dimension, .889 in the adaptive

performance dimension, and .93 in the overall scale. Ergül and Kurtulmuş (2016) have developed the "Diversity Management Scale". The scale has two dimensions as approach dimension and managerial practices dimension and contains 20 items. The Cronbach's Alpha values are .91 in the approach dimension, .88 in the managerial practice dimension, and .94 in the scale.

The reliability analysis of the scales was made by the researcher as follows:

The Cronbach's Alpha values of the Job Performance scale were found to be .937 in the scale, .892 in the task performance dimension, .844 in the contextual performance dimension, and .897 in the adaptive performance dimension.

In the Diversity Management Scale, Cronbach's Alpha values are .968 overall, .942 in the managerial practices dimension, and .956 in approaches dimension. Reliability analysis results show that it is highly reliable across the scale and in its dimensions. The high grade of reliability overall and in dimensions of the scales increases the expectation that the measurements and results of the search will be consistent.

Data Analysis

For data analysis, the data were converted into numerical values and entered into the IBM SPSS 25 software. Before the analysis, the normal distribution of the mean scores of the scales and dimensions was examined with the Kolmogorov-Smirnov test. The mean scores of the scales and their dimensions were used for the findings regarding the perception grades of the teachers about the diversity management and job performance. The relationship between the two scales was calculated by Spearman Correlation analysis as one of the scales did not conform to the normal distribution. The relation grade between the scales were arranged according to the following criteria (Alpar, 2020 p.444): 0.00-0.19 no relation; 0.20-0.39 weak relation; 0.40-0.69 intermediate grade relation; 0.70-0.89 strong relation; 0.90-1.00 very strong relation. At the same time, regression analysis was conducted to examine to what extent Diversity Management affects Teachers' Job Performance. In the analyses, a 95% confidence grade and 5% margin of error were set and in the results, the statistical value grade was seen as $p<0.05$.

Results

The Grades of School Principals' Diversity Management

Mean scores of Diversity Management Scale based on teachers' perceptions of the grades of School principals' diversity management are presented in Table 3.

Table 3.

Information on School Principals' Diversity Management Behavior Grades

Scale and Dimensions	n	x̄	*ss*
Diversity Management Scale	216	4.20	0.77
Managerial Practices Dimension	216	4.22	0.76
Approaches Dimension	216	4.18	0.85

In Table 3, it was in sight that the mean score of perceived school principal diversity management grades according to the teachers who participated in the search is (x̄=4.20). In this context, according to the teachers' perceptions, it can be suggested that school principals' diversity management grades are at a good grade, compared to the meanings of mean score on the scale. When the dimensions of the scale is evaluated, school principals indicated very well (x̄ = 4.22) performance in managerial practices dimension and a good (x̄ =4.18) performance in approaches dimension. According to these findings, it can be said that teachers are satisfied with the school principals' approach to diversity and their managerial practices.

Teachers' Job Performance Grades

The mean scores of the job performance scale, which shows the perception grades of teachers' job performances are presented in Table 4.

Table 4.

Information on Teachers' Job Performance Perception Grades

Scale and Dimensions	n	x̄	ss
Job Performance Scale	216	4.41	0.37
Task Performance Dimension	216	4.59	0.33
Contextual Performance Dimension	216	4.06	0.59
Adaptive Performance Dimension	216	4.43	0.44

In Table 4, the perception grades of the teachers found in the research regarding job performance were determined as the mean score (x̄ = 4.41) and it is in the range of "always". It is in sight that teachers' perceptions of task performance dimension (x̄ = 4.59) and adaptive performance dimension are in the range of "always", while their perceptions of contextual performance dimension (x̄ = 4.06) are in the range of "mostly". Considering the mean score of teachers' perceptions, the task performance dimension has the highest; contextual performance dimension has the lowest value.

According to the perceptions of the teachers, it can be said that they fulfill the defined tasks related to the teaching profession and adapt to changes. Contextual dimension, on the other hand, may have been perceived at a lower grade due to extra-role behaviors.

Correlation Analysis

Since the Diversity Management Scale does not agree with the normal range, the Spearman Correlation Coefficient is used to examine the relationship between the two scales. Spearman's Correlation Coefficient is the non-parametric equivalent of the Correlation Coefficient. In other words, it is the correlation coefficient used in cases where the assumption of normality is not met.

Findings regarding the relationship between school principals' grades of diversity management and teachers' job performance.

According to the perceptions of the teachers participating in the search, the findings showing the relationship between school principals' diversity management and teachers' job performance are presented in Table 5.

Table 5.

The Relationship Between Diversity Management Scale and Job Performance Scale

		n	Job Performance
	Spearman		
Diversity Management	rho	216	.465*

$p^{*} < .05$

In table 5 it is in sight that a positive 46.5% significant medium grade relation was found between school principals' skills to manage diversities and teachers' job performance (Sig.=0.000 < p=0.05). Based on this finding, it can be said that as teachers' perceptions of school principals' skills to manage diversities increase, teacher job performance also increases at a moderate grade.

In addition, according to the perceptions of the teachers participating in the search, the relationship between diversity management and the dimensions of the job performance scale was also analyzed and the findings are presented (see Table 6).

Table 6.

The Relationship Between Dimensions of Diversity Management Scale and Dimensions of Job Performance Scale

			n	Task Performance	Contextual Performance	Adaptive Performance
Diversity Management	Managerial Practices	Spearman rho	21	.353*	.355*	.400*
	Approaches		21	.350*	.423*	.433*

$p^{*}<0.05$

In Table 6, it can be seen that there was a low grade of positive correlation of 35.3% between the Managerial Practices dimension of Diversity Management and the Task Performance dimension of Job Performance, and 35.5% between the Contextual Performance dimension. Again, in the same research, it was deduced that there was a 40.0% positive and meaningful medium-grade relationship between the Managerial Practices dimension of Diversity Management and the Adaptive Performance dimension of Job Performance. To this extent, it can be expressed that as teachers' perceptions of managerial practices increase, their task performances and contextual performances will increase at a low grade, and their adaptive performances will increase at a median grade.

Similarly, as seen in the table, there is a positive and low grade of correlation of 35% among the Approaches dimension of Diversity Management and the Task Performance dimension of Job Performance. Again, a positive moderate correlation of 42.3% was found between Approaches dimension of Diversity Management and the Contextual Performance dimension of the Job Performance, and 43.3% between the Adaptive Performance dimension. According to these results, it can be said that where teachers' perception of approach to diversity management increases, the contextual and adaptive performance dimension of job performance will also increase moderately.

Regression Analysis

The regression analysis examined the extent to which diversity management affects teachers' job performance. In the regression analysis, it is sufficient for the dependent variable to provide the

assumption of normality. In this search, it is seen the mean scores of the Teacher Job Performance Scale provide the assumption of normality.

Table 7.

Regression Analysis of School Principals' Grades of Diversity Management and Teacher Job Performance

Model	B	Std. Error	p	t	F	R_S	R^2
(Coefficient)	3.577	.128	.000	27.917			
Diversity Management	.198	.030	.000	6.59	43.427	.465	.169

As seen in Table 7, school principals' grades of managing differences affect teacher job performance show that there is a positive relationship between the grade of diversity management and teacher job performance (R^2=.169). In addition, it is seen that the behavior grades of diversity management explain 16.9% of teacher job performance (R^2=.169). It was determined that the impact of diversity management practice on teacher job performance was significant (F=43.427; p=.000). The equation regarding the impact of school principals' grade of diversity management on teacher job performance can be established as follows (t=27.917; p=.000):

$$Y_{\text{Job Performance}} = 3.577 + 0.198 * X_{\text{Diversity Management}}$$

When examining the regression equation, it is seen that school principals' diversity management executions have a positive impact on teacher job performance. As a result, when one-unit increases in the values of school principals' skill to manage differences, the teachers' job performance will increase by 0.198 units. In other words, it can be stated that the diversity management has a positive impact of 19.8% on teacher job performance.

Discussion and Conclusion

The objective of this research was to analyze the relationship between school principals' grade of diversity management and teacher job performance according to teacher perceptions. Three search questions were used to achieve this aim. Discussions and conclusions regarding the analysis of the search questions are below.

In the findings of the first search question, it was determined that school principals' skill to manage differences was at a good grade according to teacher perceptions. It has been determined that

the school principals' managerial practices regarding the diversity management are at a very good grade, and their approaches to differences are at a good grade. In this context, school principals; it can be said that they have positive perspectives, managerial practices and policies against differences. In addition, it can be stated that school principals are respectful towards different thoughts, behaviors and tendencies. In the schools participating in this research, it can be mentioned that there is no discrimination and exclusion, no injustice, no ignorance of differences and there is a democratic school environment. The result regards the views of teachers and principals made in high schools (Memduhoğlu, 2011) and preschool education institutions (Memduhoğlu, & Ayyürek, 2014). Doğan, et al. (2015) showed that teachers' perception grade of diversity management was at the grade of "agree". Şahin Kılıçlar (2015) found that teachers' perceptions of school principals on diversity management were high in their search in primary schools. Keskinkılıç Kara and Alabay (2016) also concluded that teachers and school principals had high perceptions of diversity management in pre-school education. Bakaç et al. (2019) found that teachers had positive views on diversity management by school principals. Similarly, Karakaş (2021) found that school principals and teachers had a high grade of perceptions about diversity management. The results of these researches are parallel with the consequence of the current search. In Çako (2012), according to teachers' perceptions, school principals' diversity management was not at the expected level. Çetin and Bostancı (2014), according to teachers' opinions, school principals' diversity management behavior grades were at the lowest grade in the dimension of managing differences. Balay et al. (2014), diversity management is moderate according to the perceptions of principals and teachers. In Balyer and Gündüz (2010), it was deduced that the perceptions of school principals and teachers regarding management diversity in their schools were in the direction of "somewhat agree" and not very positive. The results of the present search are not supported by these studies.

In the findings of the second question, teachers' perception of their job performance levels are in the range of "always". It is seen that teachers' perceptions of task performance and adaptive performance regarding job performance are in the range of "always", and their perceptions of contextual performance are in the range of "mostly". According to the mean scores of teachers' perceptions of their job performance grades, teachers' task performance is the highest and their contextual performance is the lowest dimension. The mean scores of teachers' adaptive performance are at a value between task and contextual performance. In this context, according to teachers' perceptions, their job performance can be said to be at a very good grade. Teachers' task and adaptive performance grades can be described as very good and their contextual performances as good. In

Limon (2019), it was found that teachers' perception of their job performance, task performance, and adaptive performance related to teacher job performance were in the range of "always" and their contextual performances were in the range of "often". In several studies (Altunova, 2019; Sayın Dilbaz & Arslan, 2018; Yılmaz & Çokluk Bökeoğlu 2008), it was determined that teachers had the opinion that their performances were sufficient. The results of this previous research are similar to the results of the current research. In Sincer (2021), teachers' views on job performance were specified at the grade of "strongly agree", task performance, and adaptive performance, as the dimensions of job performance, "strongly agree", and contextual performance "strongly agree". The results of this research are also parallel with the results with the current research. One can say that the teachers who participated in this research are responsible in their duties, adaptable to changes, and mostly showed organizational citizenship behaviors (e.g. following the rules, caring about the job, volunteering to do the job, devotion to the institution). At the same time, one can say that the self-efficacy beliefs of the teachers attending in the search are at a higher grade.

The findings of the third search question show the increase in teachers' perceptions of school principals on diversity management also moderately improves their job performance. However, it can be said that school principals' skill to manage diversity is a predictor of teachers' job performance. In other words, school principals' good diversity management can positively affect teacher work performance. Pitts (2009) concluded that diversity management had a positive and strong relation with job performance and job satisfaction. In research in the textile sector (Yeşil, & Purtaş, 2018), it was concluded that diversity management had a positive impact on job performance. In research in the communication sector (Makonyango, & Bichanga, 2015), it was found that there was a positive relationship between effective managerial executions on workplace diversity and job performance. In Kocuk (2019), it was concluded that diversity management applied in enterprises had a substantial impact on employee productivity. Similarly, in research conducted in the maritime sector (Keceli et al., 2020), it was found that diversity management increased job performance and employee productivity. It can be said that the research results conform with the current research results. Bayar (2021) found that individual-grade diversity management executions had a negative impact on employee productivity, which did not support the current research's findings.

In the current research, there is a low grade of a positive and significant relationship between school principals' managerial practices regarding diversity management and teachers' task performance and contextual performance, according to teacher perceptions. It can be stated that the administrative practices of the school principals regarding diversity affects the task performance of

the teachers at a negligible grade. It can be said that this situation is related to the teachers' perspectives on the task, their work discipline, and work ethic. Contextual performances of teachers can be affected by school principals' managerial practices and approaches to diversity at a low level. As a matter of fact, the behaviors exhibited by teachers, such as volunteering, collaborative approach, commitment to organizational goals, willingness, respect for friends, and effort are reflections of contextual performance to behaviors (Robbins & Judge, 2012 as cited in Şekertağ, 2021, p.24). It can be said that the fact that teachers do their duties with extra-role behaviors is due to the love and interest they have for their profession.

Administrative practices of school principals towards diversity and their approaches to diversity affect teachers' adaptive performance positively and moderately. In other words, school principals' effective diversity management and approach to diversity can positively affect teachers' adaptation to changes. Accordingly, it can be said that teachers can readily settle with alterations in the process. It is seen that school principals' approaches to differences increase teachers' contextual performance positively and moderately. Also, the increase in the grade of the school principal's approach to differences increases the organizational citizenship behaviors, which shows the contextual performance of the teachers.

As a result, with this research, the perspectives of school principals' managerial practices of diversity management and approaches to diversity have emerged according to the teachers' perceptions. In this context, it can be said that school principals have a respectful and tolerant perception of differences. Concurrently, it can be stated that the job performance grade of teachers increases with the reflection of these perspectives on managerial practices and approaches to differences. In this case, it can be said that teachers are satisfied with the managerial understanding of school principals and their approaches to diversity. Yardibi (2018) found that teachers' satisfaction with their administrators had an impact on teachers' job performance. In the current search, it was observed that the behaviors of school principals regarding diversity management positively affected teachers' work performance. The teachers who participated in the research are thought to be the ones who commonly fulfill the defined duties of the teaching profession, are responsible, can exhibit organizational citizenship behaviors, and do not show resistance to change.

Effective diversity management in schools will increase teacher work performance. The high performance of teachers, who are a factor in the success of schools, will increase the quality of education. Thus, a qualified and trained workforce and population will be produced. In this context,

it will be possible for Turkiye to be in an important position in the competitive environment brought about by globalization.

This search reveals the impact of diversity management on teacher job performance in participating schools. It also revealed the importance of school principals' managerial understanding and approaches to diversity in terms of teacher job performance. It can be said that the research raises awareness of school principals' managerial practices and approaches to diversity by pointing out the positive impact of school principals' perspectives on diversity on teacher job performance. When the books and articles are reviewed, no research was found that investigates the relationship between diversity management and teacher job performance. Therefore, one can say that this research can contribute to the literature.

Recommendations

The research is limited to the self reports of 216 secondary school teachers working in Bakırköy district. For this reason, it is recommended to research the relationship between diversity management and teacher job performance at different grades, in different districts, and regions. Comparisons can be made between the results obtained in the previous research. The cause and impact relationship can be discussed in these comparisons. It would be beneficial to examine the search subject in the special education area as well. In this way, teacher job performance can be compared within the scope of diversity management in private and public schools. The relationship between diversity management and teacher job performance can be examined together with variables that affect performance, such as educational status and length of service in the organization. Awareness can be raised by including diversity management and teacher job performance in the in-service trainings of school principals. In addition, organizing trainings on diversity management can contribute to the effectiveness of school principals' administrative practices.

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Conflict of Interest

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Ethical Standards

The permission of this research was approved by decision number 25 of meeting number 154 of the ethics committee of Okan University held on 27.04.2022. Data were collected with the permission of the scale owners. However, volunteer teachers working in public schools participated in the research.

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References

Alpar, R. (2020). *Uygulamalı İstatistik ve Geçerlik-Güvenirlik [Applied Statistics and Validity Reliability]*. Detay Publishing.

Atunova, N. (2019). *Sınıf Öğretmenlerinin İş Performansını Etkileyen Faktörlerin İncelenmesi: Bir Q Metodu Araştırması [An investigation of factors affecting classroom teachers' job performance: A Q method analysis]*. (Unpublished master's thesis). Gaziantep University, Gaziantep.

Bakaç, N., Okçu, V., & Erdem, M. (2019). Farklılıkların Yönetimine İlişkin Okul Yöneticilerinin ve Öğretmenlerin Görüşü [Opinions of School Administrators and Teachers Related to management of Diversity]. *Anatolian Journal of Educational Leadership and Instruction, 7*(2), 19-56.

Balay, R., Kaya, A., & Geçdoğan-Yılmaz, R. (2014). Eğitim Yöneticilerinin Hizmetkâr Liderlik Yeterlikleri ile Farklılıkları Yönetme Becerileri Arasındaki İlişki. [The relationship between servant leadership competencies and diversity management skills among education managers]. *Eğitim Bilimleri Araştırma Dergisi, 4*(1), 229-249. https://doi.org/10.12973/jesr.2014.4os14a

Balyer, A., & Gündüz, Y. (2011). Yönetici ve öğretmenlerin okullarında farklılıkların yönetimine ilişkin algılarının incelenmesi [Examining the perception of administrators and teachers related to diversity management in their schools]. *M.Ü. Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi, 32*(2), 24-43.

Bayar, M. (2021). Etkili Farklılık Yönetiminin Çalışanların Verimliliğine Etkileri (Effects of Effective Diversity Management on Employee Productivity). *Journal of Business Research - Turk, 4*(13), 3835-3857. https://doi.org//10.20491/isarder.2021.1359

Bhat, S. A., & Beri, A. (2016). Development and validation of teachers perceived job performance. *Man in India, 96*(4), 935-944.

Çako, G. (2019). *İlköğretim Okullarında Öğretmen Algılarına Göre Yöneticilerin Farklılıkları Yönetimi Becerileri İle Değişime Dirençleri Arasındaki İlişki [The Relationship Between Diversity Management Skills of Administrators and Their Resıstance to Change With Respect].* (Unpublished master's thesis). Trakya University, Edirne.

Çetin, N., & Bostancı, A. B. (2011). İlköğretim Okullarında Okul Yöneticilerinin Öğretmenler Arasındaki Farklılıkları Yönetme Durumu [School Managers' Management Situation of the Differences Among the Teachers in Primary Schools]. *Sakarya University Journal of Education, 1*(2), 1-10.

Demir, E. (2019). *Notlarım: Örnekleme Kuramı. [My Notes: Sampling Theory].* Ankara University.

Dobbin, F., Kalev, A., & Kelly, E. (2007). Diversity Management in Corporate America. *Contexts, 6*(4), 21-27.

Doğan, S., Uğurlu, C. T., Topçu, İ., & Yiğit, Y. (2015). Farklılıkların Yönetimi ile Öğrenen Okul Arasındaki İlişkinin Öğretmen Algılarına Göre İncelenmesi [Examination of the Relationship between Diversity Management and Learning School according to the Teacher's Perceptions]. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi (KEFAD), 16*(2), 121-140.

Ergül, H. F., & Kurtulmuş, M. (2014). Farklılıklar Yönetimi Ölçeğinin Geçerlilik Güvenirlik Çalışması [Validity and Reliability Study of The Scale of Diversity Management]. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi, 22*, 298-312.

Harris, D. N., & Sass, T. R. (2012). Skills, Productivity and the Evaluation of Teacher Performance. *Andrew Young School of Policy Studies Research Paper Series No. 12-11W. J. Usery Workplace Research Group Paper No. 2012-3*. https://dx.doi.org/10.2139/ssrn.2020717

Inegbedion, H., Sunday, E., Asaleye, A., Lawal, A., & Adebanji, A. (2020). Managing Diversity for Organizational Efficiency. *Sage Open*, 1-10. https://doi.org/10.1177/2158244019900173

Karakaş, O. (2021). *Okullarda Farklılıkların Yönetiminin Liderlik Kapasitesiyle İlişkisi [The relationship between diversity management and leadership capacity]*. (Unpublished master's thesis). Necmettin Erbakan University, Konya.

Keceli, Y., Zaim, H., Kum, S., Dinc, M. S., & Momin, M. (2020). The Impact of Diversity Management and Leadership on Performance in Maritime Industry. *EuroEconomica Business Administration And Business Economics, 1*(39), 58-72.

Kara Keskinkılıç,S. B., & Alabay, E. (2016). Okul Öncesi Öğretmenlerinin Farklılıkların Yönetimine İlişkin Algılarının İncelenmesi [Preschool Teachers' Perception of Diversity Management]. *Hitit Üniversitesi Sosyal Bilimler Enstitüsü, 2*, 721-742. https://dx.doi.org/10.17218/hititsosbil.280813

Kevser, M. (2019). Farklılıkların Yönetimi Kavramına Yönelik Kuramsal Bir Değerlendirme.[A Theoretical Evaluation of The Concept of Diversity Management]. *Uluslararası İşletme ve Ekonomi Çalışmaları Dergis, 1*(2), 86-95.

Kocuk, D. (2019). *İşletmelerde Farklılıkların Yönetiminin Çalışan Verimliliğine Etkisi [The effect of diversity management on employee efficiency]*. (Unpublished master's thesis). Marmara University, İstanbul.

Kowo, S. A., & Akimbola, O. S. (2018). Effects of Workforce Diversity on Employees' Performance in Stallion Group of Company. *Case Studies Journal*, *7*(4), 15-30.

Lagat, A. C., Ochieng, I. O., & Owili, P. (2019). The effect of management of diversity dimensions on employee performance in selected Public Universities in Kenya. *Journal of Business and Management, 21*(11), 66-71. https://doi.org/10.9790/487X-2111046671

Limon, İ. (2019). *Eğitim Örgütlerinde Değişim Yorgunluğu, Eğitim Politikaları Bağlamında Moral Yitimi ve İş Performansı Arasındaki İlişki [The relationship among change fatigue, demoralization in educational policy context and job performance in educational organizations]*. (Unpublished doctoral dissertation). Abant İzzet Baysal University, Bolu.

Limon, İ., & Sezgin-Nartgün, Ş. (2020). Development of teacher job performance scale and determining teachers' job performance level. *Journal of Theoretical Educational Science, 13*(3), 564-590. http://dx.doi.org/10.30831/akukeg.642340

Makonyango, E., & Bichanga, W. O. (2015). Contribution Of Employee Diversity Management On Job Performance In Kenya's Telecommunication Industry. *International Journal of Social Sciences and Information Technology, 1*(5), 1-20.

Memduhoğlu, H. B. (2011). Liselerde farklılıkların yönetimi: Bireysel tutumlar, örgütsel değerler ve yönetsel politikalar [Diversity Management in High Schools: Individual Attitudes, Organizational Values and Administrative Policies]. *Mersin University Journal of the Faculty of Education, 7*(2), 37-53. https://doi.org/10.17860/efd.60648

Memduhoğlu, H. B. (2017). Farklılıkların Yönetimi. H. B. Memduhoğlu, & K. Yılmaz'da (Ed.), *Yönetimde Yeni Yaklaşımlar [New Approaches in Management]* s. 263-298. Pegem Akademi.

Memduhoğlu, H. B., & Ayyürek, O. (2014). Öğretmenlerin ve okul yöneticilerinin görüşlerine göre anaokullarında farklılıkların yönetimi [Diversity Management in Preschools in the Views of Teachers and School Administrators]. *Journal of Educational Sciences Research, 4*(1), 175-188.

Motowidlo, S. J., Borman, W. C., & Schmit, M. J. (1997). A theory of individual differences in task and contextual performance. *Human Performance, 10*(2), 71–83. https://doi.org/10.1207/s15327043hup1002_1

Mujtaba, B. G., & Mujtaba, L. (2011). Diversity Awareness And Management in Adult Education in Adult Education. *Journal of College Teaching & Learning, 1*(3), 65-74.

Onsongo, E. N., & Maina, Z. R. (2013). Employee Attitudes towards Organizational Diversity on Business Performance; Perspectives from the Small and Medium Enterprises Employees in Kisii Town. *Review of Contemporary Business Research, 2*(1), 30-40.

Pitts, D. W. (2009). Diversity Management, Job Satisfaction, and Performance: Evidence from U.S. Federal Agencies. *Public Administration Review, 69*(2), 328-338. https://doi.org/ 10.1111/j.1540-6210.2008.01977.x

Polat, S., & Arslan, Y. (2020). Farklılıklar Liderliği. K. Yılmaz (Ed.), *Liderlik Kuram-Araştırma-Uygulama (Leadership Theory-Research-Application)* 245-260. İletişim.

Polat, S., & Ölçüm, D. (2016). Characteristics of Diversity Leadership According to Teachers. . *Anthropologist,, 24*(1), 64-74. https://doi.org/10.1080/09720073.2016.11891990

Risnah, R., Fitria, H., & Setiawan, A. A. (2022). The Influence of Work Culture and Organizational Commitment on Teacher Performance. *JMKSP (Jurnal Manajemen, Kepemimpinan, dan Supervisi Pendidikan), 7*(2), 121-133.

Salajegh, S., & Tanabandeh, M. (2016). An Explanation of the Relationship Between Organizational Indifference and Job Performance of Staffs with the Mediating Role of Cultural Intelligence (A Case Study: Customs Office Staffs In Tehran). *IIOABJ, 7*(3), 452-459.

Sayın Dilbaz, S., & Arslan, H. (2018). Öğretmen ve okul yöneticilerinin performans öz değerlendirme sonuçlarının okul kademesi ve mezuniyet değişkeni açısından incelenmesi [The Investigation of Teacher and School Administrators' Performance Self-Evaluation Results in Terms of Grades of School and Graduation Factors] *Igdir University Journal of Social Sciences, 16,* 537-564.

Sincer, S. (2021). *Öğretmen Performansı, Örgütsel Sadakat ve Karizmatik Liderlik Arasındaki İlişkinin İncelenmesi: Bir Karma Yöntem Araştırması [Examining the relationship between teacher performance, organizational loyalty and charismatic leadership]*. (Unpublished doctoral dissertation). Hacettepe University, Ankara.

Singh, S. (2018). Diversity Management In The Age Of Globalisation. *Journal of Management,* 251-257.

Sürgevil, O. (2008). *Farklılık ve İşgücü Farklılıklarının Yönetimine Analitik Yaklaşım [Diversity and an analytic approach to workforce diversity management]*. (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

Şahin Kılıçlar, E. (2015). *İlköğretim kurumlarında farklılıkların yönetimine ilişkin öğretmen görüşlerinin incelenmesi. [Examining the perceptions of primary*

school teachers on diversity management]. (Unpublished master's thesis). Gazi University, Ankara.

Şahin, F., & Karakuş, Ş. (2016). Farklılıkların Yönetimi. S. Gürbüz ve H. Şeşen 'de (Ed.), *Yönetimde Güncel Konular [Current Issues In Management]* 344-365. Beta.

Şekertağ, F. (2021). *Beden Eğitimi ve Spor öğretmenlerinin pedagojik bilgi ve beceri düzeyleri ile Beden Eğitimi Öğretmenliği mesleğine ilişkin inançlarının iş performansına etkisi[The Effects of Physical Education Teachers' pedagogical knowledge and skill levels and their beliefs Regarding the Physical Education Teaching Profession on job performance.* (Unpublished master's thesis). Trabzon University.

Tozkoparan, G., & Vatansever, Ç. (2011). Farklılıkların yönetimi: İnsan kaynakları yöneticilerinin farklılık algısı üzerine bir odak grup çalışması[Diversity management: A focus group study of perception of diversity among human resource managers]. *Akdeniz İ.İ.B.F. Dergisi, 11*(21), 89-109.

Viswesvaran, C., & Ones, D. S. (2000). Perspectives on Models of Job Performance. *International Journal of Selection and Assessment, 8*(4), 216-226.

Yardibi, N. (2018). Öğretmenlerin Yöneticilerden Memnuniyet Düzeylerinin İş Performanslarına Etkisi [The Impact of Teacher Satisfaction Levels from Managers on Business Performance]. *Mersin Üniversitesi Eğitim Fakültesi Dergisi, 14*(1), 426-435.https://doi.org/dx.doi.org/10.17860/mersinefd.401087

Yeşil, S., & Purtaş, S. (2018). Farklılıkların Yönetimi, Kurumsal İtibar ve İşletme Performansı Üzerine Etkileri: Tekstil Sektöründe Bir Alan Araştırması. [The effect of diversity management on corporate reputation and firm performance: A field study in textile industry] . *Kahramanmaraş Sütçü İmam Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 2*(7), 174-194.

Yılmaz, K., & Çokluk Bökeoğlu, Ö. (2008). İlköğretim Okulu Öğretmenlerinin Yeterlik İnançları[Primary School Teachers' Belief of Efficacy]. *Ankara University, Journal of Faculty of Educational Sciences, 41*(2), 143-167.

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Examination of Seventh Grade Students' Van Hiele Geometric Thinking Levels and Their Mistakes on 'Quadrilaterals'

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Abstract. In this study, it was aimed to examine seventh grade students' Van Hiele geometric thinking levels and their mistakes on 'Quadrilaterals'. The research was conducted with ten seventh grade students and the case study model, one of the qualitative research methods, was used. The Van Hiele geometric thinking levels test developed by Usiskin and the diagnostic test developed by Başısık were rearranged and administered to the students. According to the research findings, seventh grade students have misconceptions about diagonal, height concepts and special quadrilaterals. One of the most important of these is that the square positioned on one corner cannot be recognized by students at the analysis level, but is recognized by students at the visualization level. Students at the analysis and visualization levels have different misconceptions regarding the trapezoid. While there is a misconception that all side lengths must be different from each other as a condition for being a trapezoid, there is also a misconception that having four sides is sufficient. Another one is related to the concept of diagonal. There is a misconception that shapes with equal side lengths also have equal diagonal lengths. While no errors or misconceptions were encountered in students at the informal level, misconceptions were encountered in students at the analysis level, and more errors were encountered in students who were visualization and could not be assigned to any level.

Keywords. Van Hiele geometry levels, quadrilaterals, misconceptions and errors.

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Geometry is a branch of science that makes it easier for us to understand the world we live in and even the universe from different perspectives. Geometry helps individuals gain high-level thinking skills by enabling them to comprehend the relationships between shapes and objects (Türnüklü and Berkün, 2013, p.337-356). Students' ability to recognize the geometric shapes and objects they see around them, to distinguish the similarities and differences between shapes and objects, improves their logical thinking and improves their problem-solving skills in all areas of life. For this reason, teaching the geometry objectives included in the curriculum is of great importance.

It is accepted by almost all educators that the first three levels of Van Hiele geometric thinking levels of the achievements in the primary education curriculum should be acquired by seventh grade students (Teppo, 1991, pp. 210-221). Considering that Van Hiele's levels of geometric thinking progress hierarchically, teaching geometry requires great importance and care. Students should be guided by providing necessary guidance so that they can move up to the next level. Despite all the studies carried out, it is known that students have misconceptions while learning the subjects, which prevents them from understanding the subject (Ersoy, 2019; Özkan and Bal, 2018). A student with a misconception cannot reach the desired level in Van Hiele geometric thinking levels (Ersoy; 2019).

Students come to class with a certain amount of knowledge, and what is happening around them helps them make sense of the new topics they learn. However, this interpretation is not always complete. They may experience mental confusion during this interpretation. The formations that cause confusion in their minds are misconceptions (Baki, 2006). Ubuz (1999) defines misconception as the student's perception of a scientifically defined concept as different from its scientific definition, while error is defined as inaccuracies in the answers.

Van Hiele geometric thinking model is one of the models that describe individuals' perception and interpretation of shapes and objects geometrically. Thanks to this model, students' perception of geometric shapes and objects emerges (Duatepe Paksu , 2016). While developing this model, based on the difficulties experienced by students in geometry, the reasons were revealed and solution suggestions were offered. According to this model, learning geometry occurs at five levels. These levels are hierarchical within themselves; one cannot move on to the next without completing one level. In order to complete the levels, the necessary geometric experiences must be experienced. According to the Van Hiele model, since teaching without considering the students' levels makes it difficult for students to learn geometry, it is recommended that teachers take their students' levels into consideration when planning their lessons (Usiskin, 1982).

Van Hiele Geometric thinking model is called visualization level, analysis level, informal inference level, formal inference level and systematic thinking levels. At the Visualization Level, students can distinguish the desired shape among mixed shapes. When making this distinction, they benefit from their experiences, not definitions. (Van De Walle, 2013; cited in Ersoy, 2019). Considering quadrilaterals specifically, students at this level can choose square, rectangle, trapezoid, parallelogram and rhombus among the mixed shapes. At the level of analysis, students now become interested in the properties of shapes. They know the properties of shapes in detail. For example; "A square has four angles and four sides." They can make definitions such as: At the informal inference level, associations between shapes begin. Definitions have become meaningful for students in this period, but logical inferences cannot be made in this period. The student in this period can also define a square as a rectangle. At the inference level, students can go beyond the relationship between shapes and create proofs and create theorems. At the level of systematic thinking, students can also perceive non-Euclidean geometry. They can easily work and prove different axiomatic systems (Usiskin, 1982).

The primary school mathematics curriculum objectives are examined, it is seen that square and rectangle are emphasized and their general properties are aimed to be taught. Considering the achievements, a student who completes primary school is expected to be at the level of analysis, which is the second level of Van Hiele's geometric thinking levels. When the secondary school achievements of the primary school mathematics curriculum are examined, it is seen that in the fifth grade, the general properties of quadrilaterals are given in detail and associations are made by emphasizing that the square is a special case of the rectangle. This association comes to the fore even more in seventh grade achievements (MoNE, 2018).

Quadrilaterals and polygons, which are basic concepts in geometry teaching, and Van Hiele Geometric thinking levels are examined, it is found that the subject of quadrilaterals and polygons is frequently discussed and misconceptions on this subject are revealed (Ersoy, 2019; Mutluoğlu and Erdoğan, 2020; Öksüz and Başışık, 2010; Özkan and Bal, 2018). In the study conducted by Öksüz and Başısık in 2010, it was concluded that the general properties of quadrilaterals could not be expressed correctly by fifth grade students. In addition, they observed that there were a limited number of students who succeeded in associating quadrilaterals. It was concluded that students tend to recognize geometric shapes in the first form they learned, but when the shapes are rotated, some students cannot recognize them. When Van Hiele was associated with geometric thinking levels, it was stated that most students remained at the visualization level. In their study, Mutluoğlu and

Erdoğan (2020) again discussed the subject of quadrilaterals and examined the geometric reasoning results of sixth grade students on this subject. According to the results of the research, it was observed that students with lower level reasoning power could not go beyond the models in which they were first taught geometric shapes, while students at higher levels benefited from concepts in geometric reasoning, but were still under the influence of the model they first learned. It was stated that students had difficulty in recognizing the images formed when the shapes were rotated. A study was conducted by Ersoy with seventh grade students in 2019 on the relationship between success in quadrilaterals and Van Hiele geometric thinking levels. The Van Hiele geometric thinking levels of the students in the study were lower than they should have been. It was concluded that there is a significant relationship between success in quadrilaterals and Van Hiele geometric thinking levels.

Quadrilaterals are a basic concept in teaching geometry and it can be said that it is one of the most important concepts for teaching geometry. According to the literature, it is seen that a quantitative study has been conducted examining the relationship between 7th grade students' achievements in quadrilaterals and Van Hiele geometric thinking levels with the relational screening model (Ersoy, 2019). According to this study, the students who participated in Van Hiele Although geometric thinking levels were lower than they should be, a moderate relationship was found between the scores obtained from both tests. In this study, which aims to examine this relationship qualitatively, the Van Hiele geometric thinking levels of seventh grade students and the mistakes made about quadrilaterals were examined.

Method

In this section, the type of research, selection of participants, data collection tools, data collection, process and data analysis are presented.

Research Model

Which aimed to examine the Van Hiele geometric thinking levels of 7th grade students and the mistakes made about quadrilaterals, the case study method, one of the qualitative research designs, was used. Case study is defined as a method in which the existing situation is revealed by examining one or more events in depth (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, Demirel; 2019, p.268). In this study, it was aimed to correlate students' misconceptions about quadrilaterals with their Van Hiele geometric thinking levels.

Study Group

The study group of the research consists of 10 seventh grade students studying in the Çal district of Denizli province. Clinical interviews are to be held with the students determined according to the results of the Van Hiele geometric thinking test and the diagnostic test on quadrilaterals. While forming the study group, students' first semester mathematics course grades were taken as basis. It is aimed to create a study group that includes students at all success levels. The information about the students' mathematics achievement and in-class participation is given in the table below.

In the table created according to the end-of-term report card grades, students whose grade point average is in the range of 0-50 are low achieving student, students whose grade point average is in the range of 51-65 are student at near-intermediate level, students who are in the range of 66-80 are mid-level successful student , students whose grade point average is in the range of 81-90 are successful student, students whose grade point average is in the range of 91-95 are high achieving student and students whose grade point average is in the range of 96-100 are high successful student.

Table 1.

Students' Success in Mathematics Course

Student	Math Grade	Mathematics Achievement
Ö1	100	High successful student (BİLSEM student)
Ö2	95	High achieving student
Ö3	95	High achieving student
Ö4	85	Successful student
Ö5	85	Successful student
Ö6	70	Mid-level successful student
Ö7	60	Student at near-intermediate level
Ö8	60	Student at near-intermediate level
Ö9	40	Low achieving student
Ö10	40	Low achieving student

Data Collection Tools

Van Hiele geometric thinking test was used to collect the data of the research and a diagnostic test was used to reveal misconceptions about quadrilaterals. Van Hiele Geometry test was developed by Usiskin in 1982 and adapted to Turkish by Duatepe in 2000 after validity and reliability tests were performed. In this test, there are five questions corresponding to each level, for a total of 25 questions. Since the research was limited to seventh grade students, the first fifteen of twenty-five questions were used. According to the Van Hiele Geometry test, a student who answers three out of every five questions correctly can move to the next level. Hierarchical order is important. For example, even if a student cannot reach the number of three correct numbers at the second level, but reaches the third level, he should be considered to be at the first level. He cannot move to the next level.

In order to detect misconceptions about quadrilaterals, the questions equivalent to the relevant achievements of the diagnostic test on the subject of quadrilaterals, developed by Başısık in 2010 by checking its validity and reliability, were arranged by the researcher and a 17- question diagnostic test was created by taking the opinions of field experts. This test consists of open-ended questions. For this reason, the verbal expressions that students give to the questions become very important.

Data Analysis

The Van Hiele test, students who answer at least three of the questions in the range of 1-5 correctly are at the visualization level, students who answer at least three of the questions in the range of 6-10 are at the analysis level, students who answer at least three of the questions in the range of 11-15 correctly are at the informal inference level. accepted at the level. Content analysis was used to analyze the diagnostic test. Open-ended questions were examined one by one and the obtained data were presented in tables. As a result of the association of Van Hiele and diagnostic tests, clinical interviews were conducted with students selected from the first three levels. The most important feature of the clinical interview is that it enables the researcher to communicate directly with the people to whom the research is applied (Ginsburg, cited in Karataş and Güven, 2003). In this way, a better understanding of misconceptions is achieved. The clinical interview was recorded, paying attention to the confidentiality of the individuals, and the results obtained were conveyed directly without changing the sentences using the descriptive analysis method.

Results

This section includes the findings of the research. First, the findings of the Van Hiele geometric thinking levels test are included. Afterwards, the students' answers to the diagnostic test were

discussed in terms of their Van Hiele levels, and finally, the errors and misconceptions in the diagnostic test were mentioned.

Findings on Seventh Grade Students' Van Hiele Geometric Thinking Levels

In order to determine the students' Van Hiele thinking levels, the first 15 questions of the Van Hiele test were applied to the students and the results are shown in Table 2. is also presented.

Table 2.

Van Hiele Geometric Thinking Levels Test

Student	in the range of 1-5	in the range of 6-10	in the range of 11-15	Current Level
Ö1	5	5	5	Informal Inference
Ö2	3	4	2	Analysis
Ö3	4	4	2	Analysis
Ö4	5	3	1	Analysis
Ö5	3	5	0	Analysis
Ö6	2	1	0	Could Not Assign to Level
Ö7	2	1	1	Could Not Assign to Level
Ö8	2	1	1	Could Not Assign to Level
Ö9	3	1	2	Visualization
Ö10	3	1	0	Visualization

In the student names in Table 2, the letters G, A, İ were used to represent the levels they were in during the subsequent naming. The first letter is the first letter of the geometric level it is in. No letters were used for students at the zeroth level who could not be assigned to any level. Codes were given to the students using the letter G for the visualization level, A for the analysis level, and I for

the informal inference level. When Table 2 is examined, students coded Ö2, Ö3, Ö4 and Ö5 were included in the analysis level, which is the level expected from seventh grade students. Ö1 participated at the informal level by answering all questions correctly. It can be said that 4 students could not reach any level and were at the pre-visualization level. Two students participated at the visualization level.

Diagnostic Test Visualization Level Findings

Among the questions in the diagnostic test, the relevant questions addressing the visualization level are analyzed one by one and presented in this section.

Table 3.

Distribution of Student Answers to the Second Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Rectangle Recognizes	+	+	+	+	+	+	+	+	+	+
Square Recognizes	+	+	+	+	+	+	+	—	—	+
Parallelogram Recognizes	+	+	+	+	+	+	+	+	—	—
Recognizes Rhombus	+	+	+	—	—	+	—	+	—	—

When Table 3 is examined, it is seen that AÖ4 and AÖ5, who are at the analysis level, cannot recognize rhombus. In addition, Ö6, who is at the zeroth level, recognized all the shapes. Again, Ö7, who is at the zeroth level, could not recognize the rhombus but could recognize other shapes. Ö8 at the zeroth level could not recognize the square. It was observed that GÖ9 could only recognize rectangles, even though they were at the visualization level.

Table 4.

Distribution of Student Answers to the Third Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Can Draw A Square On Dotted Paper	+	+	+	+	+	+	+	+	+	+
Can Draw a Rhombus on Dotted Paper	+	+	+	+	—	+	+	+	—	—

When we examined Table 4, it was seen that all students were able to draw a square on dotted paper. AÖ5 at the analysis level and GÖ9 at the visualization level could not draw the rhombus. In addition, while Ö10, who was at the zeroth level, could not draw, the other zeroth level students, Ö6, Ö7, and Ö8, were able to draw.

Table 5.

Distribution of Student Answers to the Fourth Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Recognizes the Square	+	+	+	+	+	+	+	+	+	+
Recognizes Parallelogram	+	+	—	+	+	+	+	—	—	—
Recognizes the Square Positioned on its Corner	+	—	—	—	—	+	—	+	+	—
Recognizes Rhombus	+	+	—	—	—	—	—	+	—	—

According to Table 5, all students recognized the square given in the classical form in the fourth question, but while İÖ1, Ö6, Ö8 and Ö9 recognized the square positioned on its corner, the students at the analysis level could not. In this question, while the rhombus was recognized by İÖ1, AÖ2 and Ö8, it was not recognized by the other students.

Table 6.

Distribution of Student Answers to Questions Five, Six and Seven of the Diagnostic Test

Student / Question	**İÖ1**	**AÖ2**	**AÖ3**	**AÖ4**	**AÖ5**	**Ö6**	**Ö7**	**Ö8**	**GÖ9**	**Ö10**
Recognizes the Trapezoid in Question 5	+	+	+	–	–	–	+	–	–	–
6. Recognizes the Trapezoid Question	+	+	–	–	–	–	–	–	–	–
Recognizes the Trapezoid in Question 7 (Daily life example)	+	+	–	–	–	–	–	–	–	–

According to Table 6, while İÖ1, who is at the informal level, and AÖ2, who is at the analysis level, recognized the trapezoid in all three questions, the other students could not give sufficient answers on this subject.

Table 7.

Distribution of Student Answers to the Eleventh Question of the Diagnostic Test

Student / Question	**İÖ1**	**AÖ2**	**AÖ3**	**AÖ4**	**AÖ5**	**Ö6**	**Ö7**	**Ö8**	**GÖ9**	**Ö10**
Can Distinguish Parallelogram and Trapezoid.	+	+	+	+	+	–	–	–	–	–

According to Table 7., students at the informal level and analysis level were able to distinguish parallelograms and trapezoids, but other students could not distinguish them.

Table 8.

Distribution of Student Answers to the Thirteenth Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Recognizes Non-Rectangular Shapes	+	+	+	—	—	—	+	—	—	—
Recognizes a Trapezoid Positioned On One of its Corners	+	+	+	—	—	—	—	+	—	—
Recognizes The Trapezoid Given in Classical Form	+	+	+	—	—	—	—	—	—	—
Recognizes the Square	+	+	+	+	—	—	—	—	—	—
Recognizes a Square Positioned On One of its Corners	+	—	—	—	—	—	—	—	—	—
Recognizes Rhombus	+	+	+	—	—	—	—	—	—	—

According to Table 8., trapezoid and rhombus were recognized only by İÖ1, AÖ2 and AÖ3, but they were not recognized by the other students. The square positioned on one corner could only be recognized by İÖ1, who was at the informal level. Detection of non-rectangular shapes could only be made by İÖ1, AÖ2, AÖ3 and Ö7.

Table 9.

Distribution of Student Answers to the Fourteenth Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Recognizes Rectangle	+	+	+	+	+	+	+	+	+	+
Recognizes A Parallelogram Positioned On One of its Corners	+	+	+	+	+	—	—	—	—	+
Recognizes a Rectangle positioned on a Corner	+	+	—	—	—	—	—	—	—	—
Recognizes Rhombus	+	—	—	—	—	+	+	+	+	—

According to Table 9, while only İÖ1, who was at the informal level, and AÖ2, who was at the analysis level, recognized the rectangle positioned on one corner, all students were able to recognize the rectangle given in classical form. While the students at the informal level and analysis level could recognize the rectangle positioned on one corner, the student at the visualization level could not. Among the students at the zeroth level, only Ö10 was able to recognize it. The rhombus in this question could not be recognized by the students at the analysis level and by Ö10.

Table 10.

Distribution of Student Answers to the Fifteenth Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Can draw the Diagonals of Quadrilaterals.	+	+	+	+	—	+	—	—	—	—

According to Table 10, it was seen that the concept of diagonal in a quadrilateral was known by İÖ1, AÖ2, AÖ3, AÖ4 and Ö6, but was not known by the other students.

Findings of Diagnostic Test Analysis Level

Among the questions in the diagnostic test, the relevant questions addressing the analysis level are analyzed and presented in this section.

Table 11.

Distribution of Student Answers to the First Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Defines the Square	+	+	+	+	+	+	+	+	+	+
Defines the Rectangle	+	+	+	+	+	+	+	—	+	+
Defines Quadrilateral	+	+	+	—	—	—	—	—	—	—
Defines Rhombus	+	+	+	+	+	+	+	—	+	+
Defines Parallelogram	+	+	+	+	+	—	+	—	—	—
Defines the Trapezoid	+	+	+	—	—	—	—	—	—	—
It completes the Diagonal	+	+	+	—	—	—	—	—	—	—
Defines the Concept of Parallelism	+	+	+	—	—	—	—	—	—	—
Defines the Concept of Height	+	+	+	—	—	—	—	—	—	—

The first question requires being able to define the given concepts. When Table 11 is examined, all students were able to define Square. While Ö8 could not define rectangle and rhombus, all other students could. While the concepts of trapezoid, diagonal, parallelism, quadrilateral and height could be defined by İÖ1, AÖ2, AÖ3, they could not be defined by other students. While the definition of

parallelogram could be defined by the students at the informal level and analysis level and by Ö7 at the zeroth level, it could not be defined by the other students.

Table 12.

Distribution of Student Answers to the Fifth and Sixth Questions of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
It may Explain why the Shape is not Crooked	+	+	+	–	–	–	–	–	–	–

İÖ1, AÖ2, AÖ3 and AÖ4 were able to explain together which of the shapes in the questions were not crooked and why. They mentioned that at least two edges should be parallel.

Table 13.

Distribution of Student Answers to the Eighth Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Diagonal Lengths of Square are Equal	+	+	+	+	+	–	+	–	+	+
Diagonal Lengths of a Rectangle are Equal	+	+	+	–	–	+	+	–	–	+
Diagonal Lengths of a Rhombus Are Not Equal	+	+	+	–	–	–	–	–	–	–

All students except Ö6 and Ö7 concluded that the diagonal lengths of the square are equal. AÖ4, AÖ5, Ö8 and GÖ9 could not comprehend that the diagonal lengths of a rectangle are equal. The students who can deduce that the diagonal lengths of the rhombus are not equal are İÖ1, AÖ2 and AÖ3. Other students thought that the diagonal lengths in a rhombus were equal.

Table 14.

Distribution of Student Answers to the Ninth Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Diagonal Lengths Determine Unequal Shapes	+	+	+	—	—	+	+	—	+	+

AÖ4, AÖ5 and AÖ8 could not correctly answer the question of identifying shapes with unequal diagonal lengths on the visualization. In this question, it can be assumed that other students know that the diagonal lengths of squares and rectangles are equal, and that they are aware that the diagonal lengths of parallelograms and trapezoids are not equal.

Table 15.

Distribution of Student Answers to the Tenth Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Draws Height in Rectangle	+	+	+	—	—	+	+	—	+	—
Draws Elevation in Rhombus	+	+	+	—	—	+	—	—	+	—
Draws Elevation in a Parallelogram	+	+	+	—	—	+	—	—	+	—
Draws the Elevation of a Rhombus Positioned on one of its Vertices	+	—	—	—	—	—	—	—	—	—

The height of the rhombus positioned on one of its corners could only be shown by drawing İÖ1, while the other students could not. It was observed that AÖ4, AÖ5, Ö7, Ö8 and Ö10 did not fully know the concept of height.

Table 16.

Distribution of Student Answers to the Sixteenth Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Determines Shapes with Equal Diagonal Lengths	+	+	+	+	—	+	+	—	—	—
Explains why	+	+	+	+	—	—	—	—	—	—

İÖ1, AÖ2, AÖ3, AÖ4, Ö6 and Ö7 were able to show shapes with equal diagonal lengths, but Ö6 and Ö7 could not explain the reason.

Diagnostic Test Informal Findings for the Inference Level

Informal questions included in the diagnostic test relevant questions addressing the inference level are analyzed and presented in this section.

Table 17.

Distribution of Student Answers to the Sixth Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
One can say that a Rhombus is also a Trapezoid.	+	—	—	—	—	—	—	—	—	—

Only İÖ1 could say that a rhombus is also a trapezoid.

Table 18.

Distribution of Student Answers to the Twelfth Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Difference between Rhombu Square	+	–	+	–	–	–	–	–	–	–
Distinction between Rectan Parallelogram	+	+	+	–	–	–	–	–	–	–
Diagonal Properties of a Trapezoid	+	+	+	+	+	–	–	–	–	–
Diagonal Properties in Parallelogram	+	+	+	–	–	–	–	–	–	–

Only İÖ1 and AÖ3 could distinguish between a rhombus and a square. İÖ1, AÖ2 and AÖ3 were able to deduce that the rectangle is also a parallelogram. İÖ1, AÖ2, AÖ3, AÖ4 and AÖ5 were able to say that the diagonal lengths of the trapezoid are not always equal. Only İÖ1, AÖ2 and AÖ3 could say that the diagonal lengths of the parallelogram are not equal.

Table 19.

Distribution of Student Answers to the Seventeenth Question of the Diagnostic Test

Student / Question	İÖ1	AÖ2	AÖ3	AÖ4	AÖ5	Ö6	Ö7	Ö8	GÖ9	Ö10
Knows that Rectangles and Squares are also Parallelograms.	+	+	+	–	+	–	–	–	–	–

İÖ1, AÖ2, AÖ3 and AÖ5 deduced that rectangles and squares are also parallelograms.

Findings from Clinical Interviews

The questions in the diagnostic test were examined, the questions with errors and misconceptions were evaluated, and clinical interviews were conducted with students determined at different levels.

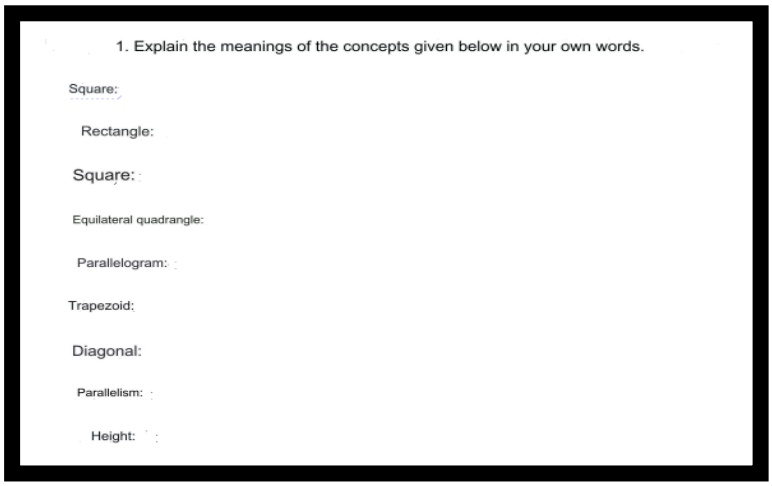

Figure 1. Question One of the Diagnostic Test.

When Figure 1 is examined, it is seen that the concepts of quadrilateral, trapezoid, diagonal and parallelism in the first question, which requires writing the definitions of the concepts, could not be answered by AÖ4 and AÖ5 at the analysis level. In the clinical interview, the first question was first asked again to the student coded AÖ4 and the following answers were received.

Researcher: For a quadrilateral, "All sides are equal." You used the expression.

AÖ4: Yes, I think so.

Researcher: Can you show the quadrilateral by drawing a figure?

AÖ4: Draws squares and rhombuses.

AÖ4 has the misconception that only shapes with four equal sides are quadrilaterals. This misconception also emerged in the thirteenth question. There again, he only expressed square and rhombus as quadrilaterals.

Researcher: For trapezoid, "None of its sides are equal." You said, can you show it by drawing?

AÖ4: Draw quadrilaterals with different side lengths.

Because of this misconception about the trapezoid, AÖ4 could not adequately answer all the trapezoid questions in the diagnostic test.

A clinical interview was also conducted with AÖ5, who left blank the concepts of diagonal, parallelism and height in the first question of the diagnostic test. As a result of the interview, it was answered that these concepts were not known to the student and therefore they were left blank. It was observed that AÖ5, who could not express height verbally, could draw the heights of the quadrilaterals in the tenth question.

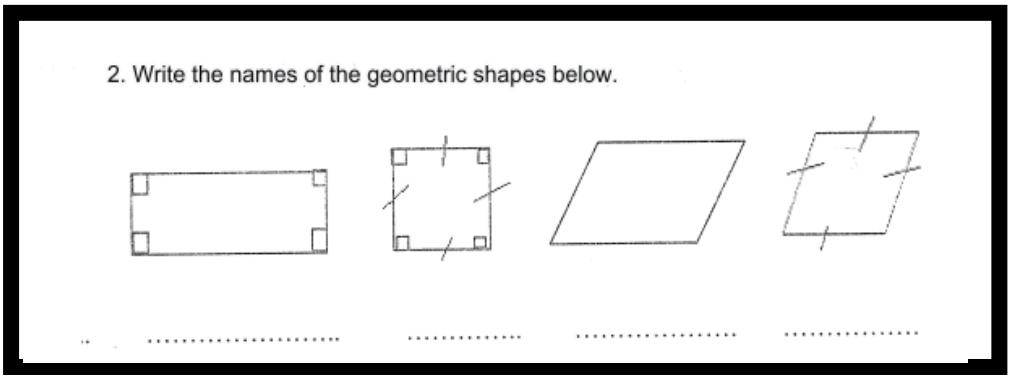

Figure 2. Second Question of the Diagnostic Test.

In the second question, it was tried to determine whether the shapes given in prototype form could be recognized by the students. AÖ4 used the expression parallelism for the figure in the fourth place, but when asked the question again in the clinical interview, he said rhombus.

Researcher: Why did you say parallelism for the fourth figure in the question?

AÖ4: When I saw the word "parallelism" in the first question, I thought it was the name of that shape.

AÖ4 made a mistake by expressing the rhombus as parallelism. AÖ5 also made the same mistake and called the figure in the fourth row a parallelism.

Researcher: Why did you say parallelism for the fourth figure in the question?

AÖ5: I couldn't find anything to say. It looked like a parallelogram, but it wasn't a parallelogram because all its sides were equal. When I saw the word parallelism in the first question, I thought it was that.

When the question was asked a second time in the clinical interview, both students corrected their mistakes and said rhombus.

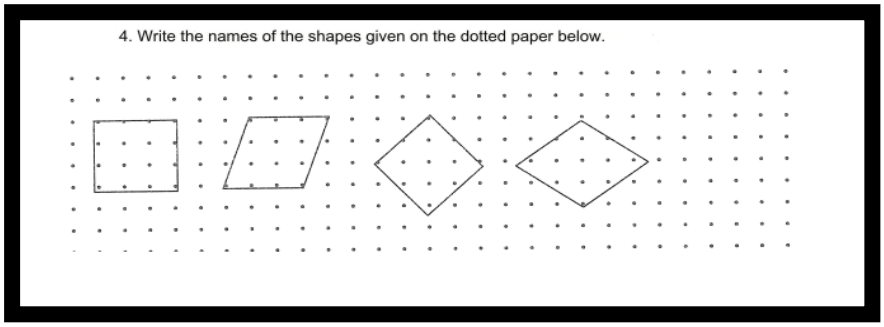

Figure 3. Fourth Question of the Diagnostic Test.

In the fourth question, it was aimed to determine whether they could recognize the square given in classical form and the square positioned on one of its corners, and whether they could distinguish between a parallelogram and a rhombus. Students at the analysis level AÖ2, AÖ3, AÖ4, AÖ5 could not recognize the square positioned on one corner. They made a misconception by calling it a rhombus. During the clinical interview, all four students admitted that the angles were ninety degrees, but they stated that they thought that way because their posture resembled a rhombus. There is a misconception that all squares have the form given in the first figure. It is seen that the students at the analysis level associate the shapes with their prototypes. There is a tendency to name shapes according to their stance. In addition, student Ö9, who was at the visualization level, and Ö6 and Ö8, who could not be assigned to any level, were able to recognize this shape.

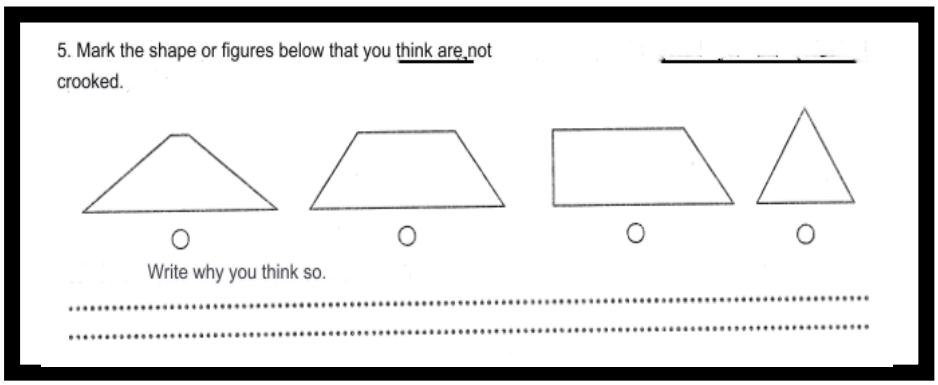

Figure 4. Fifth Question of the Diagnostic Test.

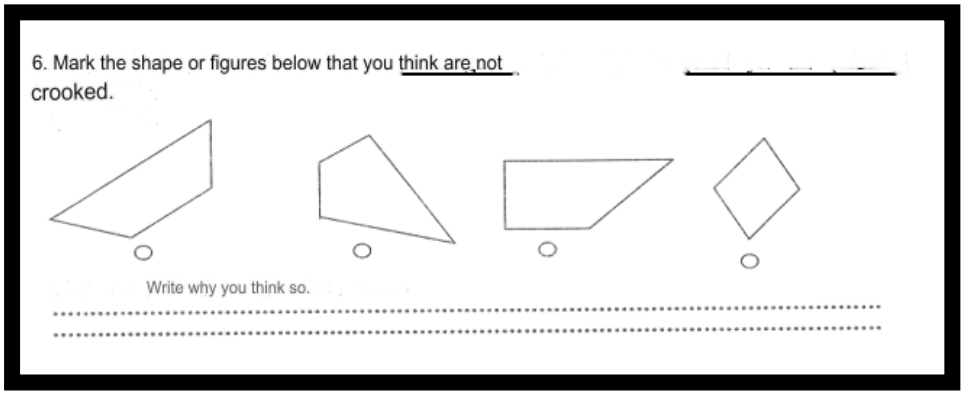

Figure 5. Question Six of the Diagnostic Test.

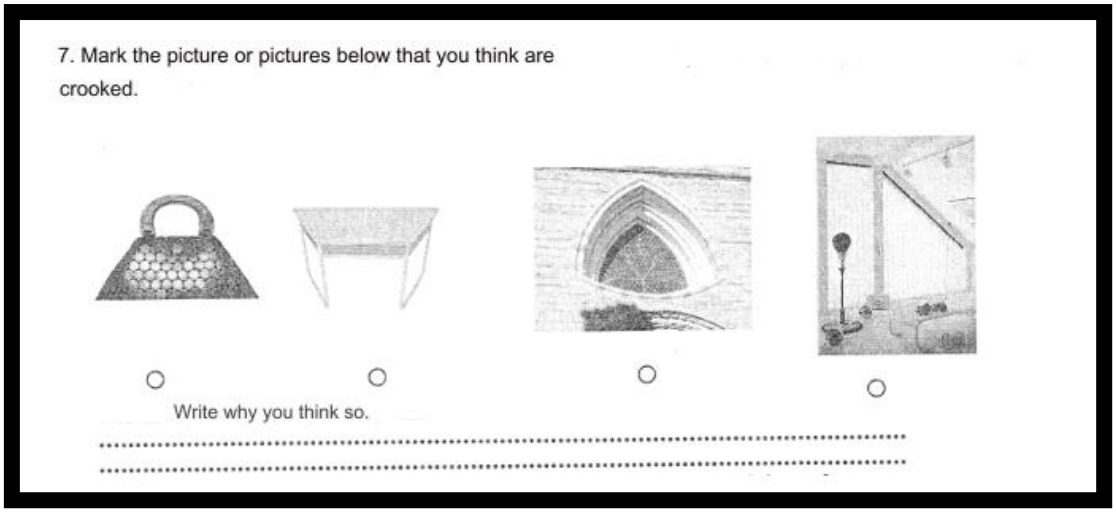

Figure 6. Seventh Question of the Diagnostic Test.

In the fifth and sixth questions, it was aimed to measure whether the trapezoid given in different shapes could be distinguished, and in the seventh question, it was aimed to measure whether the trapezoid could be recognized in the examples given from daily life. As a result of the clinical interview, it was determined that AÖ4 and AÖ5, who were at the analysis level, had misconceptions about the trapezoid. AÖ4 defined a trapezoid as 'a shape with no equal sides'. In AÖ4, there is a misconception that a trapezoid is a quadrilateral with all side lengths different from each other. He tends to describe any rhombus as a trapezoid. A similar misconception also exists in student AÖ5. He also deemed it sufficient to have four sides as a condition for being a trapezoid. He makes the mistake of describing any rhombus as a trapezoid.

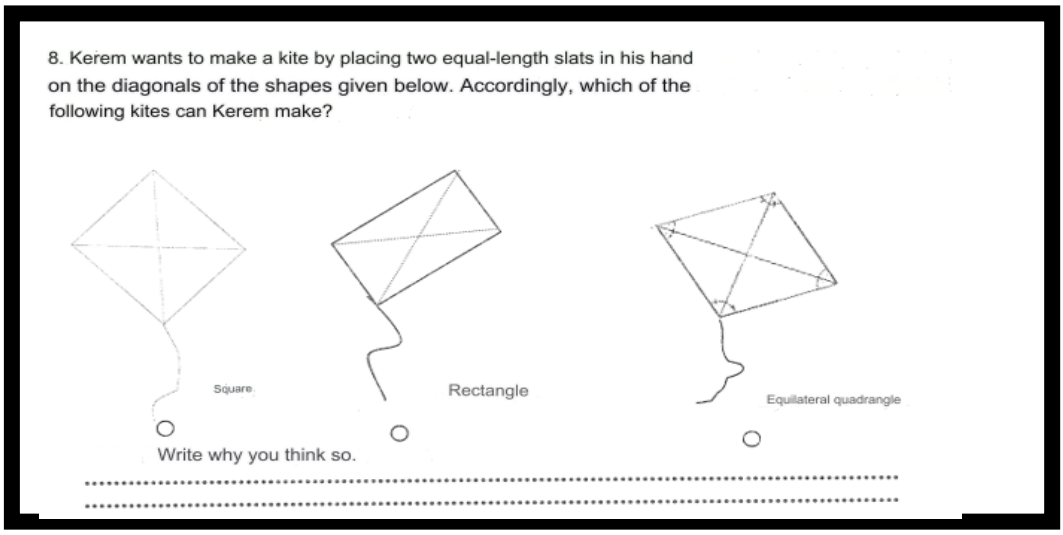

Figure 7. Eighth Question of the Diagnostic Test.

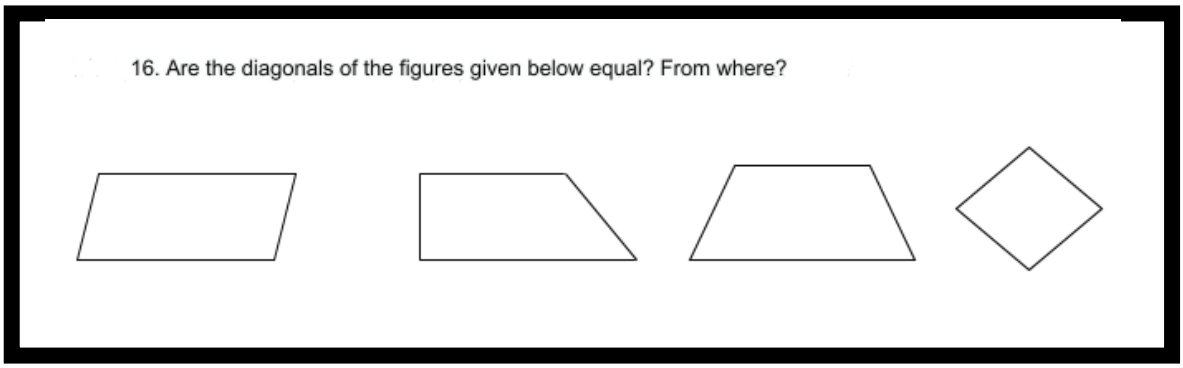

Figure 8. Sixteenth Question of the Diagnostic Test.

The eighth and sixteenth questions are about being able to express shapes with and without equal diagonal lengths. As a result of clinical interviews conducted on this question, different misconceptions emerged. AÖ5 “If the diagonals bisect each other, the diagonal lengths are equal.” He stated. AÖ4 said, "Diagonal lengths of shapes with equal side lengths are equal." has the misconception.

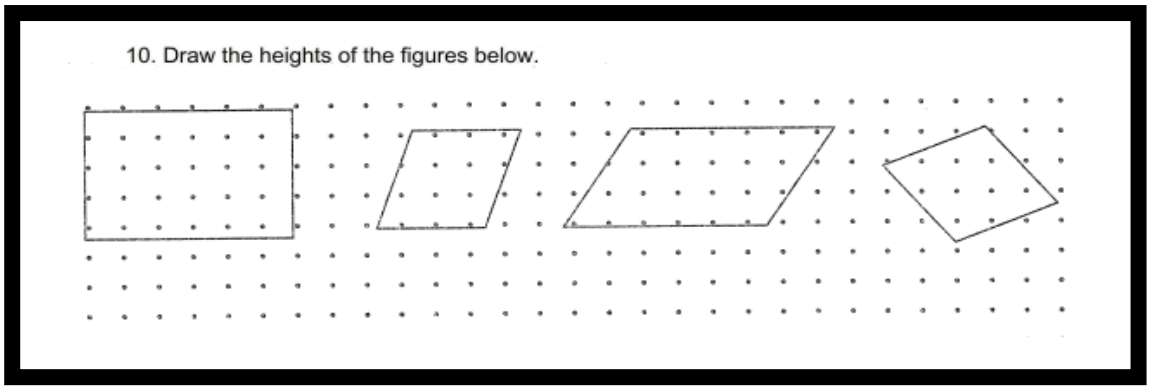

Figure 9. Tenth Question of the Diagnostic Test.

Rectangles and parallelograms had difficulty drawing the height of rhombuses and made incorrect drawings. They said that the reason for this was that they had not encountered height drawings in rhombuses before. They appear to be more familiar with drawing elevations in other quadrilaterals. AÖ3, who was at the analysis level, was able to make the correct drawing when the question was asked again in the clinical interview.

Researcher: You drew it correctly this time, why couldn't you draw it before?

AÖ3: It seemed different to me. Other shapes were easy, but that one was difficult.

Researcher: Why do you think you had difficulty?

AÖ3: I had drawn other shapes before, but the fourth shape looked different. But when you asked again, I was able to draw it perpendicularly from corner to edge and it worked.

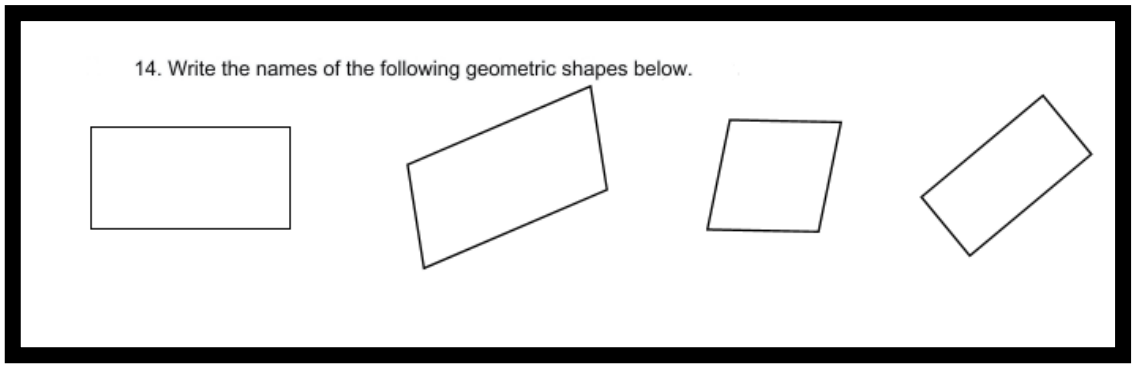

Figure 10. Fourteenth Question of the Diagnostic Test.

AÖ4 and AÖ5, who express the rectangle positioned on one of its corners as a parallelogram, have misconceptions in this regard. They stated that it looked like a rectangle, but because it looked oblique, they thought it was a parallelogram.

Discussion and Conclusion

In the study, which aimed to examine the Van Hiele geometric thinking levels of 7th grade students and their mistakes about quadrilaterals, as a result of the Van Hiele test, one out of ten students in the study group was found to be at the informal level. No errors or misconceptions were found in the diagnostic test applied to the student who was at the informal level. Four students were at the level of analysis. While the level expected from the seventh grade is to complete the analysis level, it was observed that the students at the analysis level had misconceptions about quadrilaterals. The incidence of misconceptions has increased in students who were assigned to the visualization level and who could not be assigned to any level. According to Van Hiele, they are not expected to use a scientific definition at the visualization level. At this level, they are not expected to know the properties of shapes, they are only expected to recognize shapes intuitively based on their experiences. Accordingly, depending on their visualization experience, mistakes and misconceptions about quadrilaterals can be considered natural. The fact that these ten students, who are at the same age and at the same grade level, are assigned to different levels, or even students who cannot be assigned to the level, reveals how important the experiences of the students in their daily lives outside of formal education are, regardless of the curriculum. Of course, it should not be forgotten that these students have different mathematical achievements. The student coded Ö6, who was averagely successful according to his mathematics grade, could not be assigned to any level. Accordingly, it can be said that mathematics achievement and Van Hiele geometric thinking levels do not show parallelism in the study group of this research.

Which are given as classical forms of quadrilaterals positioned on an edge, are generally recognized by students, misconceptions and errors occur regarding shapes with new appearances created by rotating them at certain angles.

If we consider the quadrilaterals one by one, it has been observed that the square given in classical form is recognized by the students, while the square positioned on one of its corners is referred to as a rhombus by the students at the analysis level. In this sense, it is similar to the study conducted by Başısık in 2010. Başısık encountered a similar result in his research to determine fifth graders' misconceptions about quadrilaterals.

While the rhombus given in its classical form, that is, positioned on its edge, was recognized by the students, it was observed that they confused the rhombus positioned on its edge with the parallelogram. Kemankaşlı and Gür encountered a similar situation in their study in 2005, and Başısık in their study in 2010.

Four different side lengths". In addition, in the question where the naming of different quadrilaterals is measured, the quadrilateral that is not a special quadrilateral and does not have parallel sides within itself was also named as a trapezoid by the students at the analysis level. It is not thought that the two sides of a trapezoid must be parallel and this causes misconceptions about the trapezoid.

At the analysis level, there are students who have the misconception that the diagonal lengths of shapes with equal side lengths are also equal. In this case, they have the misconception that the diagonal lengths of the square and rhombus are equal, but the diagonal lengths of the rectangle, parallelogram and rhombus are not equal. Some students who are at a visualization level made mistakes by confusing the concepts of corner and diagonal.

It is thought that the reason why they make mistakes when drawing diagonals in a rhombus is that the height of the rhombus is not included much in classroom activities.

Recommendations

- Van Hiele geometry levels test can be applied to students before teaching the subject of quadrilaterals. Lessons can be planned in line with the results.
- Before explaining the topic, a readiness diagnostic test should be applied to identify any misconceptions about the topic and eliminate them.
- After the subject is explained, a diagnostic test should be applied and different teaching methods should be applied in order to eliminate errors and misconceptions caused by incomplete learning, if any.
- The hierarchy of rectangles should be emphasized and plenty of activities should be done on this subject.
- While geometry teaching, the focus should not only be on prototype shapes, but also shapes with different stance positions should be frequently included in examples.

- A new study can be designed and research can be conducted to eliminate the identified misconceptions.
- The research can also be conducted to determine the relationship between misconceptions in other geometry subjects and Van Hiele levels.

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Conflict of Interest

It has been reported by the authors that there is no conflict of interests.

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Ethical Standards

We have carried out the research within the framework of the Helsinki Declaration.

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References

Aktaş, D., & Cansız Aktaş, M. (2011). 8th grade students' recognition of special quadrilaterals and their understanding of the hierarchical classification between them. *Primary Education Online, 11*(3), 714-728, 2012. [Online]: http://ilkogretim-online.org.tr

Baki, A. (2006). *Mathematics Education from Theory to Practice*, Bilge Publishing: İstanbul.

Başışık, H. (2010). *Determining the misconceptions of 5th grade primary school students about polygons and quadrilaterals.* (Unpublished master's thesis). Adnan Menderes University, Aydın.

Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, Ö. E.,Karadeniz, Ş., & Demirel, F. (2019). *Scientific Research Methods*, Ankara.

Duatepe Paksu, A., & Çontay , E.G. (2022). 8th Grade Students' Perceptions of the Definition of Square. *Erciyes Journal of Education, 6*(2), 166-190.

Ersoy, M. (2019). Examination of the relationship between *7th grade students' mathematical achievements on quadrilaterals and Van Hiele geometric thinking levels.* (Unpublished master's thesis), Erciyes University, Kayseri.

Hatip, K. (2022). Examination *of 8th grade students' Van Hiele geometric thinking levels and proof writing and justification skills.* (Unpublished master's thesis). Cumhuriyet University, Sivas.

Karapınar, F. (2017). An investigation of 8th grade students' *knowledge on geometrical objects in terms of Van Hiele Levels of understanding geometry.* (Unpublished master's thesis), Erciyes University, Kayseri.

MoNE – Ministry of National Education. (2018). *Mathematics course curriculum*. Ankara: MEB Publishing.

Mutluoğlu, A., & Erdoğan, A. (2020). 6th grade students' geometrical reasoning processes about quadrilaterals. *International Journal of Social Research, 16*(27), 236-265.

Öksüz, C. (2009, March 25-27). *Determining the misconceptions of primary school seventh grade gifted students on the subjects "Point, Line, Line Segment, Ray and Plane".* II. National Gifted Congress, Türkiye.

Öksüz, C., & Başışık, H. (2019). Determining the misconceptions of fifth grade students about polygons and quadrilaterals. *Eskişehir Osmangazi University Journal of Social Sciences, 20*(Special Issue), 413-430.

Özkan, M., & Bal, A.P. (2018). The analysis of teacher views on 7th grade students' mistakes and misconceptions. *Theory and Practice in Education, 14*(1), 81-106.

Sancar, M. (2019). *The effect of concept cartoons on eliminating secondary school students' misconceptions about triangles and quadrilaterals and their attitudes towards mathematics.* (Unpublished master's thesis). Bülent Ecevit University, Zonguldak.

Teppo, A. (1991). Van Hiele levels of geometric thought revisited. *The Mathematics Teacher, 84*(3), 210-221.

Türnüklü, E., & Berkün, M. (2013). 5th and 7th grade primary students' strategies of polygons classification. *Kastamonu Education Journal, 21*(1), 337-356.

Ubuz, B. (1999). 10th and 11th grade students' errors and misconceptions on basic geometric concepts. *Hacettepe University Faculty of Education Journal*, *17*, 95-104.

Usiskin, Z. (1982). *Van Hiele levels oath Achievement in Secondary School Geometry*. *University of Chicago*, ERIC Document Reproduction Service.

Van de Walle, J. A. (2004). *Elementary and middle school mathematics teaching developmentally*. Printed in the United States of America.

Yenilmez, K., & Yaşa, E. (2008). Primary school students' misconceptions in geometry, *Faculty of Education Journal, XXI*(2), 461-483.

Yıldırım, C. (2008). *Mathematical thinking*. Remzi Bookstore, İstanbul.

Yılmaz, H. Z. (2019). *Examination of the process of eliminating sixth grade students' misconceptions about polygons and quadrilaterals by creating cognitive dissonance with geogebra*. (Unpublished master's thesis). Gazi University, Ankara.

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Investigation of Pre-service Middle School Mathematics Teachers Habits of Mind in Pattern Generalization Problems

***İrem Coşkun, **Deniz Özen-Ünal, ***Sabahattin Eryalçın, ****Ersen Yazıcı**

Abstract. In this study, it was aimed to determine pre-service middle school mathematics teachers' habits of mind. The method of the study was determined as a case study. Participants are 23 junior pre-service middle school mathematics teachers. Data were collected with four open-ended linear and quadratic pattern problems. The clinical interviews were conducted with six of the pre-service teachers. In the analysis of the data, content analysis was carried out using habits of mind framework for pattern generalization. The results of the study show that similar habits of mind revealed by pre-service teachers in problem situations. The pre-service teachers had more difficulty in balancing exploration and reflection compared to the other. It was found that the pattern types of the problems affected the habits of mind. It is suggested that more studies need to be done to reveal and foster the quality of algebra and algebraic thinking.

Keywords. Algebra, pattern, pattern generalization, algebraic thinking, habits of mind.

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Algebra is one of the important areas of mathematics education (Akkuş İspir & Palabıyık, 2011). There are several definitions of algebra in the literature by the mathematicians and mathematics educators. While Dede and Argün (2003) defined it as a language and thinking tool, Akkaya and Durmuş (2006) defined it as the science of abstraction, in which relations are examined and transformed into equations by using symbols and numbers. Kaput (1999) defined it as the order of generalization and patterns. Vance (1998) also defined it as a way of mathematical thinking. This definition created the concept of algebraic thinking, which includes the concept of algebra. Algebraic thinking is defined as the ability to represent quantitative relationships and generalize these relationships, recognize and analyse patterns (Steele & Johanning, 2004). NCTM (National Council of Teachers of Mathematics) (2000) defined algebraic thinking as using mathematical modelling to understand quantitative relationships with the help of algebraic symbols and analysing changes in daily life situations. The fact that algebra has taken its place in every field shows us the importance of learning algebra (Williams & Molina, 1998; Girit Yıldız & Gündoğdu Alaylı, 2019). Algebraic thinking is of great importance in ensuring students' success in mathematics (Amit & Neria, 2008; Eroğlu, 2021). In this way, patterns are of great importance for students to make sense of algebraic concepts and to develop algebraic thinking, this subject was given to students along with the pattern activities used in the introduction of algebra (Palank & Akkuş Ispir, 2011). Patterns are one of the main skills in learning mathematics because it requires identifying and explaining the different and similar features of concepts (Papic, 2007).

Patterns are divided into three groups: linear, quadratic and other patterns (Yeşildere & Akkoç, 2011). Linear patterns are patterns that continue by adding or decreasing units or numbers in an invariant way at each step. Quadratic patterns, on the other hand, are patterns in which the difference between steps increases or decreases at each step.

Pattern generalization activities enable students to see the relationship between mathematical concepts. In this way, students can establish relationships and make generalizations and predictions. Understanding patterns helps students support both their problem solving and abstract thinking skills (Olkun & Toluk-Ucar, 2007). Patterns play a very important role in the development of students' algebraic thinking (Özdemir, Dikici & Kültür, 2015). Zaskis and Liljedahl (2002) argued that patterns are the heart and essence of mathematics, because everything, especially algebra, is a generalization of patterns. Hargreaves, Taylor, and Trelfall (1998) point out that patterns related to numbers, geometry, and patterns help students understand the relationship between mathematical

concepts. This relationship encourages mathematical thinking, which is the basis for learning more abstract thinking in the future (Ozdemir, Dikici, & Kültür, 2015).

It has been said that generalization is one of the important elements that will support the development of mathematical skills and mathematical thinking from an early age. This depends on studies with an appropriate teaching perspective to be determined (Tanışlı & Özdaş, 2009). One of the main purposes of mathematics teaching is generalization according to NCTM (2000) standards. Patterns can be the fundamental element of making generalizations. In generalizing patterns, an unchanging feature or relationship is discovered, an inference is made from this, a hypothesis is created from this inference, and this hypothesis is tested. Algebra is defined as "the generalization and order of patterns", as stated by Kaput (1999). In addition Lesley and Freiman (2004), Radford (2006) and Kaput (1999) have defined patterns and generalization-based teaching as an important element for developing algebraic thinking. Steele and Johanning (2004) stated that algebraic thinking forms the basis of pattern seeking and generalization. Friel and Markwoth (2009) see the disruption in the development of mathematical and algebraic thinking skills and the failure of these thinking skills to become a habit as one of the biggest reasons for failure in mathematics.

Pattern generalization problems in which different types of patterns are used, the common aspects of the steps in the pattern are determined, and the relationship between the steps is expressed in a way that is valid for each step (Radford, 2006). They support students' algebraic thinking by helping them make sense of the concepts of variable and function (Yakut Çayir & Akyüz, 2015; Radford, 2006).

Students' understanding of concepts and the development of problem solving skills are supported by teachers (NCTM, 2000). Therefore, in order for students to have algebraic thinking habits, teachers should be experienced in this subject and have relevant habits. Undergraduate education is very important for teachers to reveal habits of mind (Bülbül & Güven, 2020; Tolga, 2017; Zunlu, 2022).

Considering this situation, our study aimed to examine the pre-service middle school mathematics teachers' habits of mind in the process of solving pattern generalization problems. The research problem is 'Which habits of mind of pre-service middle school mathematics teachers' reveal in solving pattern generalization problems?'

Theoretical Framework

Habits of Mind: Habits of mind are defined as finding and applying the appropriate solution by performing high-level cognitive skills such as analysis, logical reasoning and critical thinking in the face of a problem situation (Leikin, 2007). In other words, it is a way of thinking that comes into play in cases where it is not possible to find out how to solve the problem and offers alternative options for solution (Costa & Kallick, 2000). In this process, the individual can recognize the relationships between concepts (Köse & Tanışlı, 2014). Habits of mind are divided into general habits and domain-specific habits of mind (Cuoco, Goldenberg & Mark, 1996). General habits of mind are basic skills such as making research, thinking, making assumptions, defining and visualizing (Korkmaz, 2015). Domain-specific habits of mind are discipline-specific habits such as mathematical, geometric, probabilistic, algebraic, analytical and scientific thinking (Bülbül & Güven, 2020). Mathematical habits of mind are defined as an element that enables student reasoning (Cuoco, Goldenberg & Mark, 1996) and the ability to reason by making abstractions when non-routine situations occur (Mark et al., 2010). Having mathematical habits of mind comes to the fore in areas such as algebra and geometry, and two sub-domains are formed as geometric habits of mind and algebraic habits of mind (Driscoll et al., 1996; Driscoll et al., 2007).

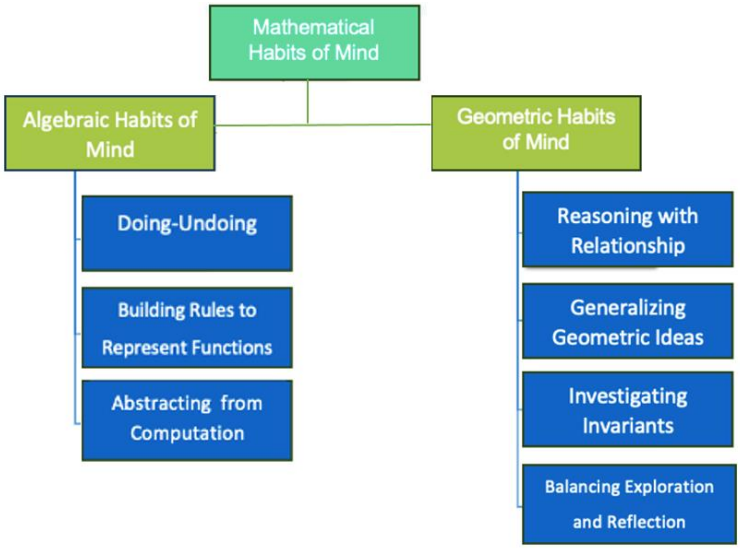


Figure 1. Mathematical Habits of Mind (Driscoll et al., 1996; Driscoll et al., 2007).

Algebraic Habits of Mind: Driscoll (1999) conceptualized two aspects of algebraic thinking, which he defined as the ability to think about functions and the effect of algebra on calculations, as Algebraic Habits of the Mind (AHoM). AHoM includes habits that an individual builds when faced with an algebraic situation (Ünveren Bilgiç & Argün, 2018). The theoretical framework of AHoM consists of three habits: "Doing-Undoing", "Building Rules to Represent Functions" and "Abstracting from Computation" (Driscoll, 1999).

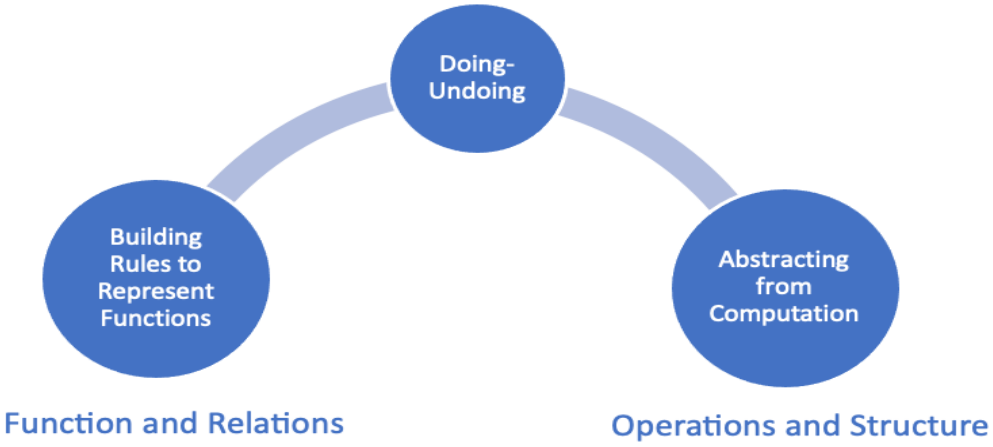


Figure 2. Algebraic Habits of Mind (Driscoll et al., 1999).

Doing-Undoing is the ability to analyze a mathematical task forward and backward in the solution process (Moyer, Huinker & Cai, 2004). The individual's ability to move from the result to the solution and provide proof is an indication that this skill is demonstrated. When solving a pattern problem, working forward from the beginning or working backwards from the result and verifying these results were revealed; so it was assumed that the doing-undoing habit was observed. For example, how many steps can be formed with the given amount in a pattern or the transformation from a shape pattern to a number pattern, from a number pattern to a shape pattern is observed. Doing-Undoing habit is addressed with the ability of understanding the problem (Schoenfeld, 2014) and this habit has some indicators. Similarly, doing-undoing habit is also inclusive for other habits, and it can occur in every problem solving situation (Eroğlu & Tanışlı, 2017). Building Rules to Represent Functions is a habit defined as seeking for patterns among the expressions given in a problem situation and making generalizations if a rule is found. It enables organizing data and determining input and output (Karyağdı, 2023). Actions such as seeking for the patterns, finding the rule of the pattern, identifying the general rule via representations can be used. In this habit, individuals try to concretize the process by thinking about different representations, looking for patterns, organizing the information given, using different representations (e.g. numerical, verbal,

symbolic), and investigating the variant and invariant situations in the question. Abstracting from Computation is the habit to find operational shortcuts in solving the problem situation and to reach generalizations rather than operations. In this habit, the following behaviours are observed; generalizing by using the relationships between addition, subtraction, multiplication and division operations, transforming knowledge to develop shortcuts, knowing the meaning of the symbols and using them easily, using equivalent expressions by simplifying or complicating them depending on the need, and performing calculations on different systems. In other words, individuals think of operations in this habit independently of numbers (Driscoll, 1999).

Geometric Habits of the Mind: Geometric habits of mind are defined as ways of thinking that support the learning and application of the concepts of geometry (Köse & Tanışlı, 2014). Cuoco, Goldenberg and Mark (1996) describe it as the ability to reason, investigate geometric invariants, think of extreme values, visualize and manipulate. Driscoll et al. (2007) designed a theoretical framework based on their study "Fostering Geometric Thinking: A Guide for Teachers Grades 5-10". The theoretical framework consists of four basic components: "Reasoning with relationships", "Generalizing geometric ideas", "Investigating invariants" and "Balancing exploration and reflection".

Reasoning with relationships is the ability to determine the relations of congruence and similarity between geometric figures and objects or between themselves or with other figures and objects. Students think about how emerging relationships can help their understanding of geometric structures and problem solving processes (Uygan, 2016). The main indicators of this habit include the identification of the figures, the correct listing of their properties, relating the figures through symmetry and proportional reasoning (Driscoll et al., 2007). Generalizing geometric ideas is the ability to understand and define concepts while generalization. The questions at this point are "Does this happen in every case?" (Driscoll et al., 2007). It enables the determination under which conditions the feature or the relationship emerge (Köse& Tanışlı, 2014). The indicators of the habit of generalization are predicting general situations, checking these predictions, tabulating responses for these predictions, and making discussions according to the predictions made on the tabulating responses (Driscoll et al., 2007). Investigating invariants is considering what variant or invariant in the problem situation. Examining which features of the geometric figure change or not under such as translation, reflection and rotation can be given as examples of situations where this habit can be demonstrated (Tolga, 2017). “What are the differences between these figures?” can be an internal question of this habit. Balancing exploration and reflection habit involves using different strategies

in solving the problem situation and evaluating these strategies. “What happens if I (draw a picture, add to/take apart this picture, work backward from the ending place, etc.)?” questions can be given as examples. The indicators of this habit are designing plans for a solution by making additional drawings on the figure, putting plans into action and checking them regularly to come up with new ideas (Driscoll et al., 2007).

When we examine the characteristics of the GHoM, it is concluded that there is no hierarchical structure between habits and more than one habit can be revealed at the same time in the same problem situation (Gürbüz, 2021).

Habits of Mind for Pattern Generalization: AHoM and GHoM are composed of common ways of thinking that can be observed in solving mathematical problems on different subject areas (Eroğlu, 2021). Patterns provides students with an introduction to algebra and the development of their algebraic thinking habits (Tanışlı & Özdaş, 2009; Radford, 2006). Eroğlu (2021) adapted a habits of mind framework that could be used in the teaching of the pattern of common which to suit the structure of GHoM (Driscoll et al., 2007) and AHoM (Driscoll, 1999).

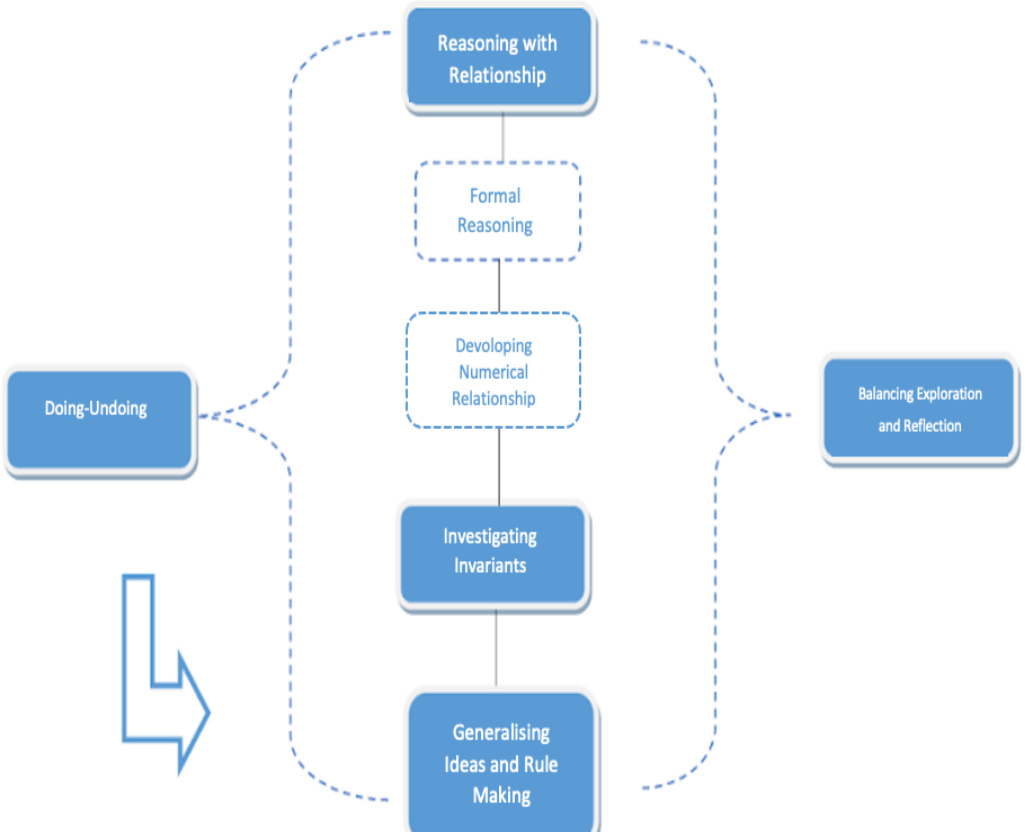


Figure 3. Habits of Mind for Pattern Generalization (Eroğlu, 2021, p.66)

According to Eroğlu's (2021) adapted theoretical framework; doing-undoing habit is defined as the ability to start from the beginning and work forwards or backwards in a pattern problem and to write symbolic relations by considering the visual structure of the pattern. Reasoning with relationships habit is characterized by the ability to determine the relationship between the components of the pattern, between the number of steps and the number of terms. Investigating invariants habit is described as the identification of variant and invariant elements in the structure of the pattern. Generalizing ideas and rule making habit is identified the ability to make generalizations regarding the further steps of the pattern by inferring the earlier steps of the pattern, and to determine whether the general rule of the pattern explained algebraically is valid at each step. Finally, balancing exploration and reflection habit is stated as the ability to try and evaluate various ways.

Method

Research Model

In this study, we aimed to examine habits of mind of preservice middle school mathematics teachers revealed while solving pattern generalization problems. In this qualitative study, the design of the research was selected as a case study. We believed that this design provides researchers to examine the case in depth and focus on the relationships between context and situation that are revealed in every aspect (Yıldırım & Şimşek, 2013). The case in this study is to examine the habits of mind revealed in pattern generalization problems of different pattern types. Since there is more than one analysis unit in this research, an embedded single-case design was used (Yin, 2003).

Study Group

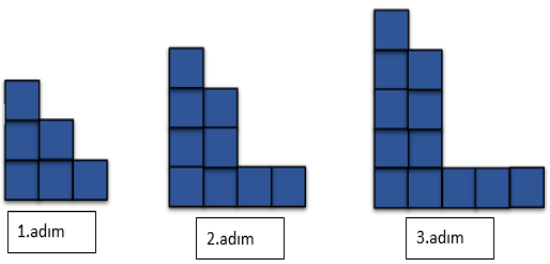
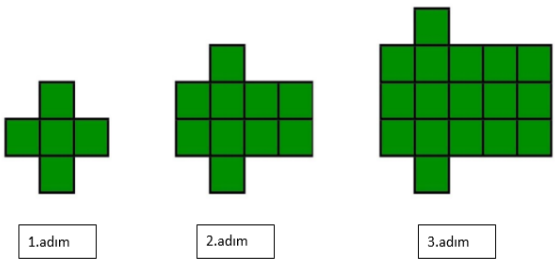
This study was conducted with 23 junior undergraduate students enrolled in the Middle School Mathematics Teacher Education Program in the academic year 2021-2022. While determining the participants, criterion sampling was used as one of the purposive sampling methods (Büyüköztürk et al., 2008). The criteria of the study were determined as being volunteered to participate in the study and being enrolled in the undergraduate level Mathematical Reasoning class where they gain experiences with pattern generalization problems.

Data Collection Tools and Processes

In the study, four pattern generalization problems were used as data collection tools. Two of the problems consist of linear patterns and the other two have quadratic patterns. Three of the problems were adapted from the pattern generalization problems used in the Mathematics Project PDST (Professional Development Service for Teachers) (URL-1) (2 quadratic and 1 linear). One of them was selected from Stacey (1989) study on linear pattern problems. While selecting the problems, the researchers considered different types of patterns that would most accurately reflect the habits of mind of the participants. Expert opinion was obtained and the final version of the problems revised according to the feedback received. The ethical permissions for the application was obtained and a consent form was filled out by the participants. The pre-service teachers were asked to answer the problems within 120 minutes. Before the application, the pre-service teachers were informed to explain their ways of solving the problem in detail. The problems are given in Table 1.

Table 1.

Pattern Generalization Problems

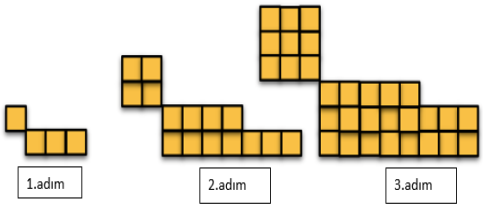
Problem 1	Problem 2
	
Örüntünün bir sonraki adımını bulmak için kaç farklı yol kullanabiliriz. Açıklayınız Örüntünün 10. adımında deseni yapmak için kaç kare gereklidir? Örüntünün genel terimini yazınız.	Örüntünün 5. Adımını bulmak için kaç farklı yol kullanabiliriz. Açıklayınız Örüntünün 20. adımını oluşturmak için kaç kare gereklidir? Örüntünün genel terimini yazınız.
Project Math (PDST, 2021)	Project Math(PDST)(2021)

Problem 3

Örüntünün 4. adımındaki şekil kaç farklı yol ile bulunabilir? Açıklayınız
Örüntüde her üçgen bir çam ağacı katını göstermektedir. Örüntünün 20. Adımında kaç lamba ve çam ağacı katı bulunur ?Bunu nasıl bulduğunuzu açıklayınız.
Örüntünün genel terimini bulunuz.

Stacey (1989)

Problem 4



Örüntünün 4.adımındaki şekil kaç farklı yol ile bulunabilir? Açıklayınız

Örüntünün 30. Adımında kaç kare bulunur?

Örüntünün genel terimi nedir?

Project Math(PDST)(2021)

Köse and Tanışlı (2014) emphasized the importance of researcher observation notes and clinical interviews in addition to the worksheets to provide an in-depth explanation of the process, due to the results they obtained from the study they conducted with pre-service teachers. Starting from this point, individual clinical interviews were held with six pre-service teachers for data triangulation to understand their written statements more clearly. The pre-service teachers were given their own solutions and were expected to explain the approach that the researchers found inexplicit.

Data Analysis

The data were analysed according to the components of Eroğlu's (2021) habits of mind theoretical framework adapted from Driscoll (1999) and Driscoll et al. (2007). Internal validity was ensured by diversifying the data collection through the worksheets and clinical interview records. In order to ensure transferability, the data are described in detail. In order to ensure the consistency and the confirmability of the research, several data collection tools were used. The analysis of the data was carried out according to the theoretical framework. The analyzes were held by two coders and the inter-rater reliability percentage was found 0.86 which indicates high reliability (Miles & Huberman, 1994). The analyses were finalized while the consensus was reached between the coders.

Results

In the study, the findings of 23 pre-service teachers (PTs) regarding 4 problems with 3 stages are given below (R: Researcher, PT1, PT2….. PT23). The findings of the study are presented according to the habits in the framework. In each section, we represented the habit revealed in the patterns which are linear or quadratic.

Doing – Undoing

Linear Pattern Generalization Problems:

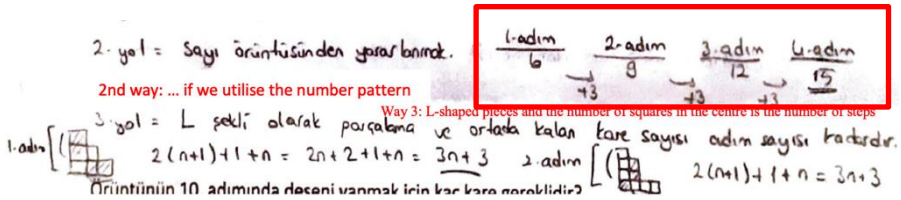


Figure 4. PT 11's solution to Problem 1.

In the first stage of the first problem, PT11 transformed the problem into a number pattern, found the general term and calculated the number of squares in the next step of the pattern using the general term. At the point of finding the number of squares, doing-undoing habit has been revealed. Then PT11 tried to generalize the pattern rule by using the visual sequence and developed a strategy based on dividing the shape into an "L" shape.

R: Why did you use a number pattern?...

PT11: It is easier and can be recognized by counting.

R: Well, can you explain what you did on the 3rd way?

PT11: I thought of the 3rd way as "L", I kept the square in the corner fixed outside and thought of it as one more square (than the previous steps)

In this problem, PT11 demonstrated this habit by working forward and backwards from the beginning.

Quadratic Pattern Generalization Problems:

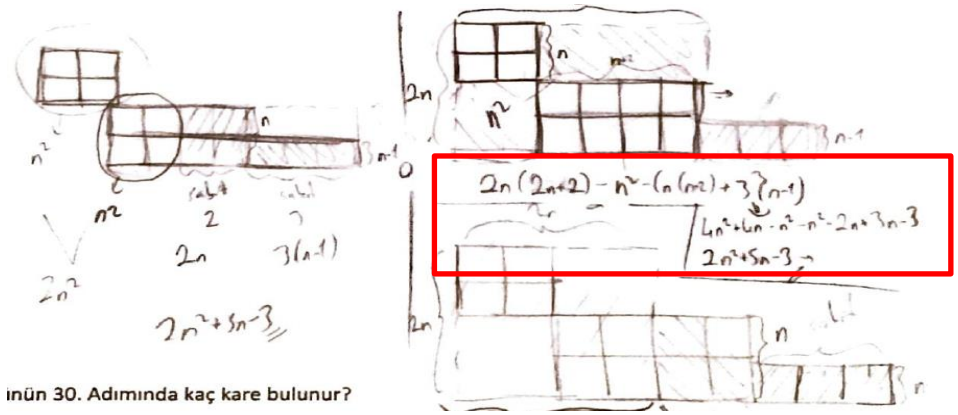


Figure 5. PT 8's solution to Problem 4.

PT8 tried to find the next step of the pattern by finding the general term in the first stage of the fourth problem. As a second way, PT8 tried to make an inference from the structure of the patterns.

R: What exactly did you do in problem 4?

PT8: It was difficult to find from the number pattern, I found n squares, I divided them into parts.

R: Can you try the number pattern?

PT8: In order to refer to the number pattern, I first look at the number of steps. It does not increase regularly, so it is difficult to find from the number pattern. I took it apart.

R: What did you notice when dissecting?

PT8: I completed (the shape) as a rectangle and focused where the invariant increase was found.

PT8 tried to focus on the structure of the pattern and transfer his/her determined information into symbolic relations as a generalization by using the abovementioned way of thinking which was coded as Doing – Undoing habit of mind.

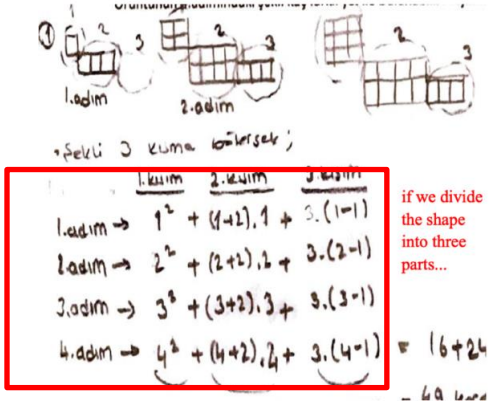


Figure 6. PT 20's solution to Problem 3.

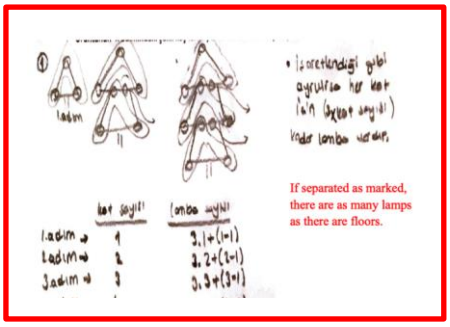


Figure 7. PT 20's solution to Problem 4.

In the first stage of the third problem, PT20 transformed the problem into a number pattern, examined the structure of the pattern within the scope of variant and invariant and tried to find it with different methods. Similarly, in the first stage of the fourth problem, PT20 also transformed the problem into a number pattern. S/he calculated the difference between consecutive terms and found the general term. PT20 calculated the number of terms in the next step (4th step) of the pattern using the general term.

Reasoning with Relationships

Linear Pattern Generalization Problems:

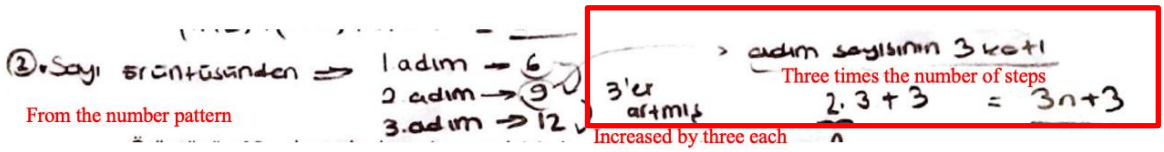


Figure 8. PT 6's solution to Problem 1.

Unlike other participants, PT6's habit of reasoning with relationships was revealed in the first problem. PT6 transformed the pattern into a number pattern and put it in a table. S/he associated the number of steps and the amount of increase with the number of terms. PT6 associated the general term with the amount of increase and this represented the indicators of the reasoning with relationships habit.

Quadratic Pattern Generalization Problems:

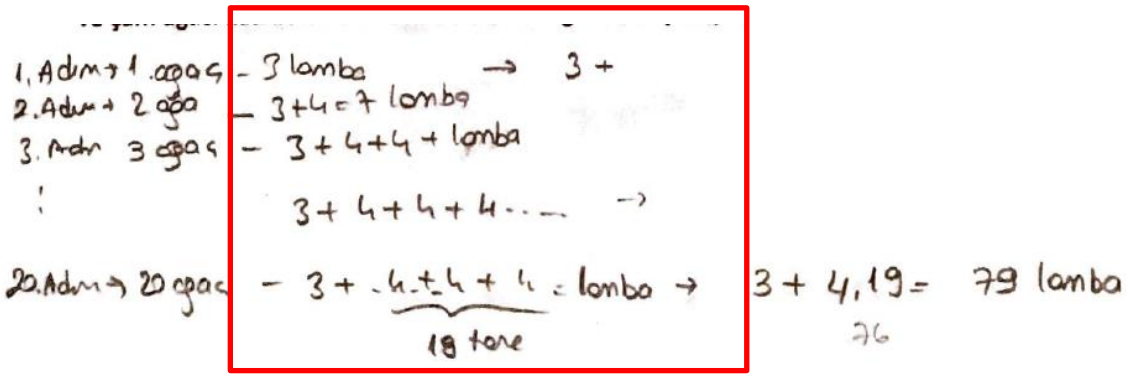


Figure 9. PT15's solution to Problem 3.

PT15 linked the amount of the triangles in each tree with the number of steps in his/her answer to the second stage of the third problem. By transforming the pattern into a number pattern form, the increase between the sequential steps was determined. PT15 established a relationship between the amount of the lamps and the number of steps such that (n-1). These are marked as an indicator of reasoning with relationships in his/her solution.

Investigating Invariants

Linear Pattern Generalization Problems:

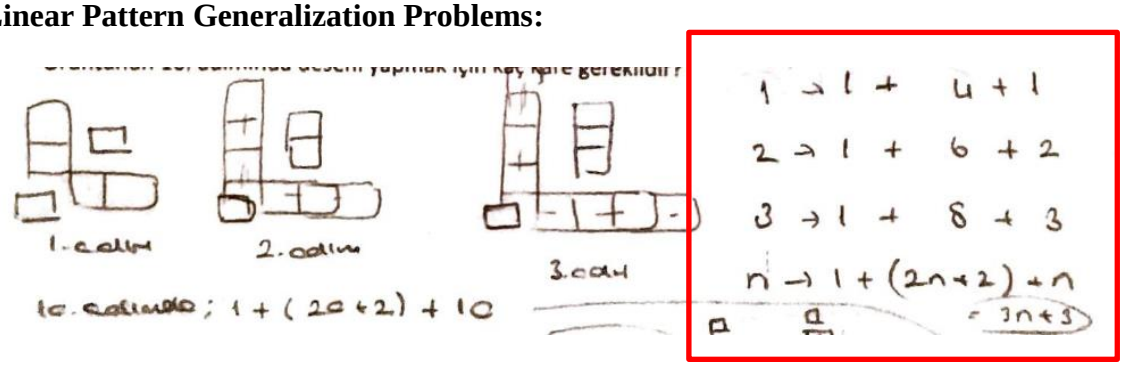


Figure 10. PT 9's solution to Problem 1.

PT9, in the second stage of the first problem, the investigating invariants habit was revealed. S/he visualized the structure of the pattern as three separate parts as given in Figure 10. S/he assumed the square located the left corner in the pattern as invariant and the remainders as growing elements.

R: Did you notice a new (solution) approach here?

PT9: In step 10, I chose one of my approach. I found it to be two more than twice the fixed number of steps. I found it from the general formula. If it was lower, I would still start from the general formula. Since I use the general term, I have shown and also found the number pattern from the path.

R: You have noticed many different ways in this pattern compared to other patterns, what is the reason for this?

PT9: The number pattern does not seem good to me, I liked this question because it is a figural pattern. I don't like the rules in number patterns, sometimes they do not make sense. It becomes more concrete with the figural patterns and I can make sense of it. I utilize the number pattern in solving the figural pattern, but it is weird to make use of the figural pattern in the number pattern and a way of solution is disappeared. Another reason I liked this pattern was that the pattern was constantly increasing when compared to the other patterns…

While identifying and working on the variants and invariants of the pattern, PT9's explanations and ways of thinking are considered to be an indicator of the habit of inversigating invariants.

Quadratic Pattern Generalization Problems:

In the abovementioned section (Figure 9), we tried to represent the problem solving process of PT15 in terms of reasoning with relationships habit. In addition to this, we noticed that PT15's approach also revealed investigating invariants habit. In each step s/he considered two sections by means that three lamps were constant and the other lamps were rounded up to four. His/her interview indicates the investigating invariants habit in a quadratic pattern problem context by him/her to investigate variants and invariants.

R: How did you proceed in the third problem?

PT15: … There were lamps, I tried dividing them. I divided the rows and columns like a square. I thought the top (lamp) was constant, and starting from this point I found a number pattern... There is a relationship of "step equals to the amount of the trees" between (amount of) the tree and the number of the steps in the pattern. I divided the lamps and the number of steps into two parts and I thought of it as two parts. There are three lamps in the first part, and four lamps in each other step. Three lamps are constant. In every step of the pattern, (total amount of) the lamps are rounded up to four. In each, the top of the triangles is ignored. As a second way, I focused on the ignored tops and replaced them with the missing ones. If there was one on the vertex of each triangle, there would be extras. I have 3 triangles, there were extra ones from each. I tried many ways, (but) this question was different.

R: What sets this question apart from others?

PT15: It seemed different to me that there were patterns consisting of triangles and lamps and different figures such as squares, there was no familiar pattern shape, and as far as I noticed, the pattern was not growing regularly.

Generalising Ideas and Rule Making

Linear Pattern Generalization Problems:

We observed in PT10's worksheet that s/he approached the first problem in two different ways. In the first one, s/he determined the last row (2n) and the first row (+1) as constant and stated that there was always the same increase in the forthcoming steps (n+2). In the second approach, s/he transformed the visual pattern into a number pattern (5, 7, 9) and formed the general formula (3n+3) based on the amount of increase (2n+3) and the constant figure in the middle (n).

During his/her problem solving process, generalizing ideas and rule making habit revealed by reaching the general term with the help of the relationship between the number of steps and the number of terms. While observing his/her process of reaching the general term from the interview records, we inferred that PT10 focused the earlier steps of the pattern at first and the invariants of each step to draw a conclusion. Finally, we noted that s/he employed earlier findings to generate further deductions to generalize the rule of the pattern.

R: Can you explain what you did in the third and fourth approach to find step 10?

PT10: I found the amount of increase through the number pattern. I determined the constant figure based on (the structure of) the first figure the previous step. There is a constant figure at the heart, and the steps continue to increase as they grow.

R: What did you consider as invariant?

ÖA10: The part with two in the first column.

R: Could we have chosen any other option?

PT10: I can take one constant (figure) from each step, I can choose the L shape which I chose in the fourth way… I can take the increase as the number of steps times two. I could have taken the top figure as an invariant and added the bottom ones one by one… I took the invariants over the visual pattern formulas

and found a relationship between the number of steps and the number of terms according to the amount of increase. I found the general term and then cross checked my answer.

Quadratic Pattern Generalization Problems:

In this problem, PT10 considered the lamps on the ends of the pine trees as 2n and the one lamp at the top as constant, as a total of 2n+1. Afterwards s/he determined the increase in each step as 2.(n-1) and formed the general term as 4n-1 from the algebraic expression [2n+1+2.(n-1)=4n-1].

R: What kind of a path did you follow here?

PT10: I tried to go through finding the total amount of the lamps. I have counted the lamps, if the amounts of the increase are invariant… They have increased by four in each step. I thought I could find the amount of the lamps this way. Twice the number of steps come from here. I considered the lamp on the top as constant. I can get the bottom or top constant as well, or I can get all three constants like a giant pine tree.

When PT10's worksheets and his/her interview were considered together, we noticed that s/he understood the structure in the pattern, determined the relationship and definedthese relationship in an algebraic way, that indicated the habit of generalizing ideas and rule-making.

Balancing Exploration and Reflection

Linear Pattern Generalization Problems:

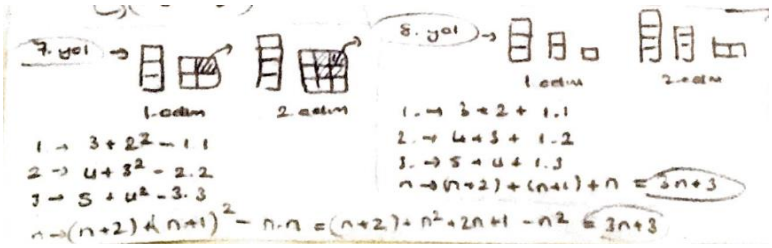


Figure 11. PT 9's solution to Problem 1.

PT9 approached more than one strategy for the first problem. Some of these strategies made it easier to reveal all habits of mind with different approaches. When these approaches are examined separately, strategies for understanding figural patterns (Figure 11) and using earlier steps to form a general term ($3+2^2$-1.1, $4+3^2$-2.2, $5+4^2$-3.3, …) are the indicators that balancing exploration and reflection habit was revealed. Also, s/he preferred at least two different approaches as visual strategies was an indicator of this habit.

Quadratic Pattern Generalization Problems:

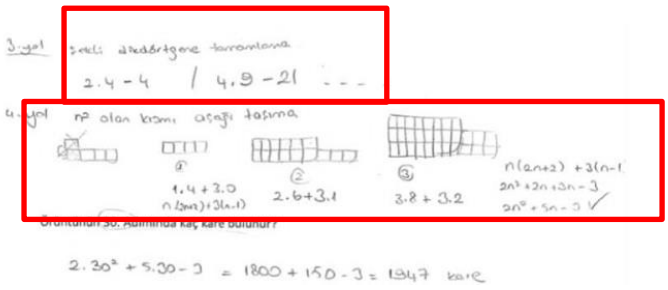


Figure 12. PT 7's solution to Problem 4.

PT7 approached this problem by dissecting the figure into smaller parts, completing the given figure into a familiar one, and transferring among representations. His/her approach showed us that several representations were used and more than one algebraic expressions were included indicating that the balancing exploration and reflection habit.

Discussion and Conclusion

This study aimed to examine the habits of mind of pre-service middle school mathematics teachers' in the process of solving pattern generalization problems in terms of the framework by Eroğlu (2021). When the results of this study were examined, all of the habits in the framework were revealed during pattern generalization problem solving similar to the study by Karyagdi (2023). Also, Tolga (2017) stated that teachers were preferred familiar strategies inevitably which resulted in the occurrence of the habits being limited.

In our study, the most common habits occurred were "reasoning with relationships" and "generalizing ideas and rule making" habits. "Doing-undoing" habit has often been seen together with "reasoning with relationships" habit. The least common habit was "balancing exploration and reflection".

Particularly, the "doing-undoing" habit was revealed in the stages that required to find each step of the pattern. For this reason, the doing-undoing habit is least common in the stages required to find the general term. While considering this habit, it was observed that the majority of the pre-service teachers focused on number patterns rather than figural patterns. In this context, the results of our study are in line with Yıldız and Gündoğdu Alaylı (2019), Barbosa and Vale (2015), Tanışlı and Köse (2011), Karyağdı (2023), Chua and Hoyles (2010), Akkan and Çakıroğlu (2012), Becker and Rivera (2006). In addition to these studies, Yeşildere and Akkoç (2011) also observed that the

participants used figures only to convert them into number patterns, and therefore the figures could not be used effectively in terms of recognizing the structure of the pattern.

The "reasoning with relationships" habit was revealed in all the stages that aimed at finding the steps of the pattern, as it was in the "doing-undoing" habit. Reasoning with relationships habit has been one of the most used habits. Bülbül and Güven (2020) also obtained similar results in their study.

We observed "investigating invariants" habit in the first and second stages of the problems while trying to determine the structure of the pattern. It is also seen that pre-service teachers apply different approaches from each other and thus this resulted in various habits revealed in the same problem by each student. This result is in line with Yakut Çayir and Akyüz (2015) in this context. However, Köse and Tanışlı (2014) determined that the participants did not have original ways of thinking, which are indicators of habits of mind, and that they faced the most common approach.

"Generalizing ideas and rule making" habit observed the first and third stages of the problems. In Particular, finding the general term and generalized the patterns was revealed in the problem solving process. Within this context, the connection between fostering generalizing ideas and rule making habit and using the pattern generalization problems are crucial. As stated in Yakut Çayir & Akyüz (2015) pattern generalization problems ease individuals to identify, expand and explore the pattern so that they can be used as a transition from arithmetic to algebra.

In our study "balancing exploration and reflection" habit was revealed rarely in the pattern generalization problem solving process. Also, this habit was observed as it was embedded with other habits. Similar to our results, Tolga and Cantürk Günhan (2019) stated that this habit was the least common and the most difficult to consider. Contrary to this result, Bülbül and Güven (2020) determined that balancing exploration and reflection habit was revealed more than other habits. Based on these results, researchers (Bülbül& Güven, 2020; Tolga& Cantürk Günhan, 2019) concluded that this habit was observed with reasoning with relationships.

In terms of the types of patterns presented in the problems, we observed different habits revealed in linear and quadratic patterns. With this result, we conclude that the structure and type of the pattern used in the problem can affect the occurance of habits. Pre-service teachers found quadratic patterns more difficult and therefore we observed less developed strategies according to the habits of mind. During the interviews, the pre-service teachers stated that they could not find the

quadratic type patterns familiar and they could also not reason that they could not recognize the pattern stem from its structure.

In her study Yakut Çayir (2013) found that students' performance was better in linear pattern problems when compared to quadratic ones. Similarly, Türkoğlu and Yalın (2020) and Özdemir, Dikici and Kültür (2015), Orton and Orton (1999), Akkan and Çakıroğlu (2012), Lannin (2005) found that participants had difficulty in identifying the general rule of the pattern in quadratic pattern problems.

Reccommendations

In this study, pattern generalization problems were examined within the scope of habits of mind. The subject of patterns is one of the important subjects of algebra. Algebraic thinking can be fostered through generalizations (Kieran, 2004), so that this can be achieved via pattern generalization problems. More studies need to be done to reveal and support the quality of algebra and algebraic thinking. It is thought that the increase in studies will improve the teaching of these subject. In this study, figural patterns are included. There is a need for studies to observe the pre-service teachers' and students' habits of mind revealed in order to observe the development of their ways of thinking and to foster their habits.

Further studies can investigate habits of mind in pattern generalization problems in different settings.

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We have carried out the research within the framework of the Helsinki Declaration; the participants are volunteers and know that they can give up if they do not want to participate the research. The research does not include any harmful implementation or the researchers do not obtain any special or sensitive information from participants. Necessary permissions are taken from the relevant institution

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References

Akkan, Y., & Çakıroğlu, Ü. (2012). Doğrusal ve ikinci dereceden örüntüleri genelleştirme stratejileri: 6-8. sınıf öğrencilerinin karşılaştırılması. *Eğitim ve Bilim, 37*(165), 105-121.

Akkaya, R. & Durmuş, S. (2006). İlköğretim 6-8. sınıf öğrencilerinin cebir öğrenme alanındaki kavram yanılgıları. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 31(*31*),* 1-12.

Amit, M., & Neria, D. (2008). Rising to the challenge: Using generalization in pattern problems to unearth the algebraic skills of talented pre-algebra students. *ZDM Mathematics Education, 40,* 111-129. DOI 10.1007/s11858-007-0069-5

Barbosa, A., & Vale, I. (2015). Visualization in pattern generalization: Potential and Challenges. *Journal of the European Teacher Education Network, 10,* 57-70.

Becker, J. R., & Rivera, F. (2006). Sixth graders' figural and numerical strategies for generalizing patterns in algebra. *November Proceedings of The 28th Annual Meeting of The North American chapter of the international group for the psychology of mathematics education, 2,* 95–101.

Bülbül, B. Ö., & Güven, B. (2020). Öğretmen adaylarının geometrik düşünme alışkanlıklarının değişimi. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 48,* 431-453. doi: 10.9779/pauefd.513220

Büyüköztürk, Ş., Kılıç-Çakmak, E., Akgün, Ö., Karadeniz, Ş., & Demirel, F. (2008). *Bilimsel araştırma yöntemleri.* Pegem Akademi.

Chua, B. L., & Hoyles, C. (2010). Generalisation and perceptual agility: how did teachers farein a quadratic generalising problem?, *12*(1), 71-72.

Costa, A. L., & Kallick, B. (2000). Discovering and exploring habits of mind. *Explorations in Teacher Education, 36,* 36-38.

Cuoco, A., Goldenberg, P. & Mark, J. (1996). Habits of Mind: An Organizing Principle for Mathematics Curricula. *Journal of Mathematical Behavior, 15*(4), 375-402.

Çayir M. Y. (2013) *9. sınıf öğrencilerinin örüntü genelleme problemlerini çözme başarılarının ve kullandıkları stratejilerin belirlenmesi.* (Unpublished doctoral dissertation). Balıkesir University, Balıkesir.

Çayir, M. Y., & Akyüz, G. (2015). 9. sınıf öğrencilerinin örüntü genelleme problemlerini çözme stratejilerinin belirlenmesi. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi*, *9*(2), 205-229.

Dede, Y., & Argün, Z. (2003). Cebir, öğrencilere niçin zor gelmektedir. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *24*(24), 180-185.

Driscoll, M. (1999). *Fostering algebraic thinking: A Guide for teachers grades* Portsmouth, NH: Heineman 6-10.

Driscoll, M., Wing DiMatteo, R., Nikula, J., & Egan, M. (2007*). Fostering geometric thinking: A guide for teachers grades 5-10*. Portsmouth, NH: Heineman.

Eroğlu, D. (2021). Yedinci Sınıf Ders Kitaplarındaki Örüntüler Konusunun "Zihinsel Alışkanlıklar" Perspektifinden İncelenmesi. *Ulusal Eğitim Akademisi Dergisi*, *5*(1), 62-78. DOI: 10.32960/uead.878814

Eroğlu, D., & Tanışlı, D. (2017). Zihnin cebirsel alışkanlıklarının sınıf ortamına entegrasyonu. *İlköğretim Online*, *16*(2), 566-583.

Friel, S. N., & Markworth, K. A. (2009). A framework for analyzing geometric pattern tasks. *Mathematics teaching in the Middle school*, *15*(1), 24-33.

Gürbüz M. Ç. (2021). *Ortaokul öğrencilerinin cebirsel kavramları soyutlama süreçlerinin incelenmesi.* (Unpublished doctoral dissertation) Bursa Uludağ University, Bursa.

Hargreaves, M., Shorrocks-Taylor, D., & Threlfall, J. (1998). Children's strategies with number patterns. *Educational Studies*, *24*(3), 315-331.

İspir, O. A., & Palabıyık, U. (2011). Örüntü temelli cebir öğretiminin öğrencilerin cebirsel düşünme becerileri ve matematiğe karşı tutumlarına etkisi. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, *30*(30), 111-123.

Kaput, J. (1999). Teaching and learning a new algebra with understanding. In E. Fennema, ve T. Romberg (Eds.*), Mathematics classrooms that promote understanding,* (s. 133-135).Mahwah, NJ: Erlbaum.

Karyağdı. F. (2023). *7. sınıf öğrencilerinin zihnin cebirsel alışkanlıklarının incelenmesi.* (Unpublished doctoral dissertation). Tokat Gaziosmanpaşa University, Tokat.

Kieran, C. (2004). Algebraic thinking in the early years. What is it*? The Mathematics Educator*, *8*(1), 139–151.

Korkmaz, S. (2015). *Problem çözmede matematiksel zihin alışkanlıklarının matematik öğretmenleri ve sekizinci sınıf öğrencileri bağlamında incelenmesi*. (Unpublished doctoral dissertation), Abant İzzet Baysal University, Bolu.

Köse, Y. N. & Tanışlı, D. (2014). Sınıf öğretmeni adaylarının geometrideki zihinsel alışkanlıkları. *Kuram ve Uygulamada Eğitim Bilimleri, 14(3*), 1203-1230.

Lannin, J. K. (2005). Generalization and justification: The challenge of introducing algebraic reasoning through patterning activities. *Mathematical Thinking and learning*, *7*(3), 231-258.

Leikin, R. (2007). *Habits of mind associated with advanced mathematical thinking and solution spaces of mathematical tasks.* In the Proceedings of the Fifth Conference of the European Society for Research in Mathematics Education (2330-2339). Larnaca, Cyprus.

Mark, J., Cuoco, A., Goldenberg, E. P., & Sword, S. (2010). Contemporary curriculum issues: Developing mathematical habits of mind. *Mathematics Teaching in the Middle School*, 15(9), 505-509.

Miles, M. B. and Huberman, A. M. (1984). *Qualitative data analysis: An expanded sourcebook* (2nd ed.), Thousand Oaks, CA: Sage.

Moyer, J., Huinker, D., & Cai, J. (2004). Developing algebraic thinking in the earlier grades: A case study of the US Investigations curriculum. *The Mathematics Educator*, *8*(1), 6-38.

National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics*. Reston, VA.

Olkun, S., & Toluk Uçar, Z., (2007) *İlköğretimde Etkinlik Temelli Matematik Öğretimi,* Ankara, (3. Baskı), Maya Akademi Publishing.

Orton, A., & Orton, J. (1999). Pattern and the approach to algebra. In A. Orton (Ed.), Pattern in the teaching and learning of mathematics. *London and New York, NY: Cassell.*144-160.

Özdemir, E., Dikici, R., & Kültür, M. N. (2015). Öğrencilerin Örüntüleri Genelleme Süreçleri: 7. Sınıf Örneği. *Kastamonu Eğitim Dergisi*, *23*(2), 523-548.

Papic, M. (2007). Promoting repeating patterns with young children-more than just alternating colours!. *Australian Primary Mathematics Classroom*, *12*(3), 8-13.

Radford, L. (2006). Algebraic thinking and the generalization of patterns: A semiotic perspective. In S. Alatorre, J. L. Cortina, M. Saiz, & A. Mendez (Eds.*). Proceedings of the 28th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (*Vol. 1*, pp. 2-21). Merida, Mexico: Universidad Pedagogica Nacional.

Zazkis, R., & Liljedahl, P. (2002). Arithmetic sequence as a bridge between conceptual fields. *Canadian Journal of Science, Mathematics and Technology Education*, *2*, 91-118.

Schoenfeld, A. H. (2014). *Mathematical problem solving*. Elsevier.

Stacey, K. (1989). Finding and using patterns in linear generalising problems. *Educational Studies in Mathematics*, *20*(2), 147-164.

Steele, D. & Johanning D.I. (2004). A Schematic–Theoretic View of Problem Solving and Development of Algebraic Thinking. *Educational Studies in Mathematics, 57,* 65–90.

Tanışlı, D. & Özdaş, A. (2009). İlköğretim Beşinci Sınıf Öğrencilerinin Örüntüleri Genellemede Kullandıkları Stratejiler. *Educational Sciences: Theory & Practice, 9*(3), 1453-1497.

Tanışlı, D., & Yavuzsoy, K. N. (2011). Lineer şekil örüntülerine ilişkin genelleme stratejileri: Görsel ve sayısal ipuçlarının etkisi. *Eğitim ve Bilim, 36*(160).

Tolga, A. (2017). *Ortaokul matematik öğretmenlerinin zihnin geometrik alışkanlıklarının belirlenmesi ve derslerine yansıması.* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

Tolga, A., & Günhan, B. C. (2019). Ortaokul matematik öğretmenlerinin zihnin geometrik alışkanlıklarının belirlenmesi. *Batı Anadolu Eğitim Bilimleri Dergisi*, *10*(1), 37-56.

Türkoğlu, H., & Yalın, H. İ. (2020). Sınıf Öğretmeni Adaylarının Lineer ve Lineer Olmayan Örüntüleri Genelleme Stratejileri. *Başkent University Journal of Education*, *7*(1), 110-128.

URL-1 Project Math. (2022, January). *"Post Primary Mathematics".* https://www.projectmaths.ie/

Uygan, C. (2016). *Ortaokul öğrencilerinin zihnin geometrik alışkanlıklarının kazanımına yönelik dinamik geometri yazılımındaki öğrenme süreçleri* (Unpublished doctoral dissertation). Anadolu University, Eskişehir.

Ünveren-Bilgiç, E. N., & Argün, Z. (2018). Examining middle school mathematics teacher candidates' algebraic habits of mind in the context of problem solving. *International e- Journal of Educational Studies (IEJES), 2*(4), 64-80.

Vance, J. (1998). Number operations from onalgebraic perspective. *Teaching Children Mathematics, 4*, 282-285.

Yeşildere, S. ve Akkoç, H. (2011). Matematik öğretmen adaylarının şekil örüntülerini genelleme süreçleri. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 30*, 141-153.

Yıldırım, A., & Şimşek, H. (2013). *Sosyal bilimlerde nitel araştırma yöntemleri.* Ankara: Seçkin Yayıncılık.

Yin, R. K. (2003). *Designing case studies*. Qualitative research methods, 5(14), 359-386.

Yıldız, D. G., & Alaylı, F. G. (2019). Ortaokul matematik öğretmen adaylarının sabit değişen şekil örüntüsü genellemesini öğretmek için matematik bilgileri. *Trakya Eğitim Dergisi*, *9*(3), 396-414.

Zunlu, M. (2022). *Ortaokul matematik öğretmeni ve 7. sınıf öğrencilerinin problem çözme süreçlerinin zihnin geometrik alışkanlıkları bakımından incelenmesi* (Unpublished master's thesis). Necmettin Erbakan University, Konya.

Williams, S. E., & Molina, D. (1998). Algebra: What all students can learn?. *The nature and role of algebra in the K-14 curriculum*, 41-44.

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Using Bingo Games in Teaching "Jobs" in English

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Abstract. Children learn more easily through playing games. For that reason, a teacher needs to use educational games to set an effective learning environment. In this study, it was aimed to get the opinions of primary school 4th grade students about teaching "jobs" subject using bingo game. The study was conducted using a quasi-experimental design with pre-test – post-test control group. A pre-test and post-test, a game evaluation form, an attitude scale and a semi-constructed interview with the teacher were used as data collection tools. Pre-test and post-test results of the students showed that the game had positively affected the learning of the students and students stated that they had a lot of fun while playing and learned while playing.

Keywords. Jobs, bingo game, educational games, learning English.

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Games are of great importance for both children and adults, and they affect the social, emotional, physical and cognitive development of all people. Piaget defines 'game' or 'play' as a means of getting to know the world (Piaget, 1952). On the other hand, Vygotsky emphasises the effect of games on children's social development by expressing that the game enables the child to develop socially (Nicolopoulou, 1993). Children get to know their surroundings, themselves and objects by playing games and they learn how to learn. They develop their own interests and abilities through games. According to Ministry of National Education (2014), a game is a process which may be with or without rules; a game may have aims or not; a game forms the basis of a child's cognitive, physical, social, language and emotional development in which a child participate willingly and happily; a game is the part of a real life; and also is the most effective learning process for a child (MoNE, 2014, p.5). Games are very important in the development and education of a child. For a child, game means understanding life, researching, recognizing and finding its purpose, learning new information, rearranging and restructuring his/her knowledge (Ramazan, 2013, p.2).

Educational games are exercises that are prepared for the purpose of gaining certain outcomes in learning environments at school or outside, and games help the child's mental or physical development in which he/she feels comfortable (Foulquie, 1994, p.370). Educational games are all of the activities, which are competitive or collaborative, individual or with a group, that have educational values, are planned in accordance with the purposes of teaching, require special materials and have their own rules. Any game that serves the goals of education is considered as an educational game (Tural, 2015; Özgenç, 2010, p.19). In order to use the educational games in a learning environment, it is necessary that the games be simple and understandable, interesting and appropriate for the age of the students. Learning and development can take place together with educational games when the requirements mentioned in the former sentence are met (Ülküdür and Bacanak, 2013, p.30).

Using games in foreign language teaching enables students to use and communicate in the target language while playing and also makes it easier for them to learn the intended words in the target language without being aware of it. According to Kara (2010), using game in language teaching enables the child to act freely, respect social rules, interact with people, learn by giving attention to the game, develop their decision making and reasoning abilities, explore nature by recognizing its real aspects and build a world of dreams him/herself (Kara, 2010).

The most important task in the process of preparing an educational game belongs to the teachers and a teacher needs to make a preliminary preparation first. A teacher should assess the game's

appropriateness for the students' age and level. Afterward, they should create a game designed to captivate the students' attention and interest. The game should be easy, understandable, and aligned with their achievements. Importantly, it should entertain students while facilitating learning without them realizing (Güneş, 2015).

Based on the information above, the aim was to teach the subject of "jobs" which is included in the 4th grade primary school English curriculum by using job bingo game that is adapted and edited by the researchers. The name of the jobs, bingo cards and all other necessary materials in the job bingo game were determined by the researchers and a suitable game for the level of students was produced. For this purpose, answers to the following questions were sought:

- What is the effect of the job bingo game on teaching the subject of "Jobs"?
- What are the opinions of the student participants about the job bingo game?
- What are the attitudes of the student participants towards the job bingo game?
- What are the opinions and suggestions of the teacher about the jobs game?

Method

The type of research, research group, data collection tools, validity and reliability, data collection techniques, analysis of the data are explained in this section.

Research Model

In this study, a quasi-experimental design with pre-test – post-test control group was used to measure the effect of bingo game on learning English. Pre-test – post-test control group design was applied by measuring the dependent variable of the subjects both at the beginning and after the experimental study. The subjects are divided into two as experimental and control groups (Karasar, 2005, p.87).

Study Group

The research was applied to 120 students (64 girls, 56 boys) at a primary school in Eskisehir Odunpazarı district in the 2022-2023 academic year. There were four different classes in fourth graders. Each class had 30 students and students were divided randomly into two groups as experimental and control groups (60 students in each group). Since the participants of the study were not adults, the researchers granted parental consent forms from the parents of the students before the game activity. The teacher in this game activity was also one of the researchers in this study. As he

was also the teacher of the school, he was all in the game. The other researcher was actively observing the students and after the game activity, she helped the teacher with the game evaluation process and made the interview with the teacher.

Data Collection Tools

A pre-test was applied to the students before the lesson and then the subject of "jobs" was taught to the students in the control group with classical methods like grammar-translation method which focused on the memorization of vocabulary and grammatical rules; the subject was taught using the bingo game in the experimental group. At the end of the lesson, the success of students was measured by applying the pre-test as post-test to the students in both groups.

In the pre-test and post-test used, there existed 30 questions having information about the jobs students were familiar with. The researchers asked the students in both groups to find the job using their knowledge about jobs. Then the subject was taught with grammar translation method in control group and bingo game was used in experimental group for teaching the subject. The list of job names used in the test were given in Table 1. After the bingo game, same test was applied to the experimental group as the post-test In choosing the vocabulary used to describe what a job does or where a job works, it is ensured that the words were in line with the English language curriculum of fourth grades. The students were familiar with the words that describe the places where a job works are they had learnt them in "In My City" unit in third grade; and the sentences were made in simple present tence which the students learnt in Unit 6 in fourth grade. Some of the questions in the pre/post-tests were;

- *She is a _____. She works at a school. She teaches students.*
- *He is a _____ He works at a police station. He catches criminals.*
- *He is a _____. He works at an airport. He flies planes.*

Table 1:

Vocabulary List Used in Pre-test and Post-test

JOBS					
Teacher	Student	Hairdresser	Dentist	Engineer	Architect
Actor	Actress	Barber	Vet	Fireman	Housewife
Waiter	Waitress	Businessman	Doctor	Nurse	Worker
Cook	Scientist	Lawyer	Farmer	Policeman	Artist
Singer	Dancer	Tailor	Pilot	Policewoman	Postman

In order to get the opinions of the students about the job bingo game, a game evaluation form consisting of three parts was distributed right after the game; considering that the students might have

difficulty in answering the questions in the game evaluation form, it was prepared in Turkish to get correct more reliable information from the students, The first part of the form included the demographic information of the students; the second part of the form included a 10 – item attitude scale with a reliability coefficient of 0,8. The scale was adapted from Akkuzu's (2005) study in which the researcher used this scale of 12 items to measure the attitudes of the students towards the game in this study. The third part of the form included 4 open ended questions in order to get the students' views on the game. Expert opinions were sought while preparing these open-ended questions. The questions used in the game evaluation form were as follows;

- What are your three favorite aspects of this game?
- Compare this lesson including bingo game with lessons without games,
- Have you learned more easily with this game?

  Yes, because…

  No, because…
- In your opinion, should the game be changed? If yes, write with reasons.

Finally, after the job bingo game, a semi-structured interview was held with the English teacher to get his views on the effect of the game on students' vocabulary acquisition and motivation levels. The questions used in the interview were as follows:

- How were the motivations of the students?
- Was the bingo game suitable for the students' level?
- Do you think the game was effective for vocabulary acquisition?
- Would you use this bingo game for vocabulary acquisition?
- Do you think the game has changed classroom atmosphere?
- How did the first and last finishers act during the game?
- How were the students' attitudes towards the game?
- Do you think the game affected the students' exam results positively?
- Is there anything you want to add?

Description of the Game

Game Materials

The following materials were used in the job bingo game:

- **Bingo cards** having pictures of 12 different jobs on each card (Figure 1),
- A PowerPoint presentation that include the introduction of the jobs such as:

  - She is a teacher. She works at a school. She teaches students,

  - He is a pilot. He works at an airport. He flies planes,

  - She is a dentist. She works at a dental hospital. She pulls out teeth,

  - He is a farmer. He works on a farm. He grows fruit and vegetables, etc.
- Surprise box (Figure 2),
- 12 small pieces of paper for each student to cover the pictures,

A sample of bingo cards prepared for this game can be seen in Figure 1 below:

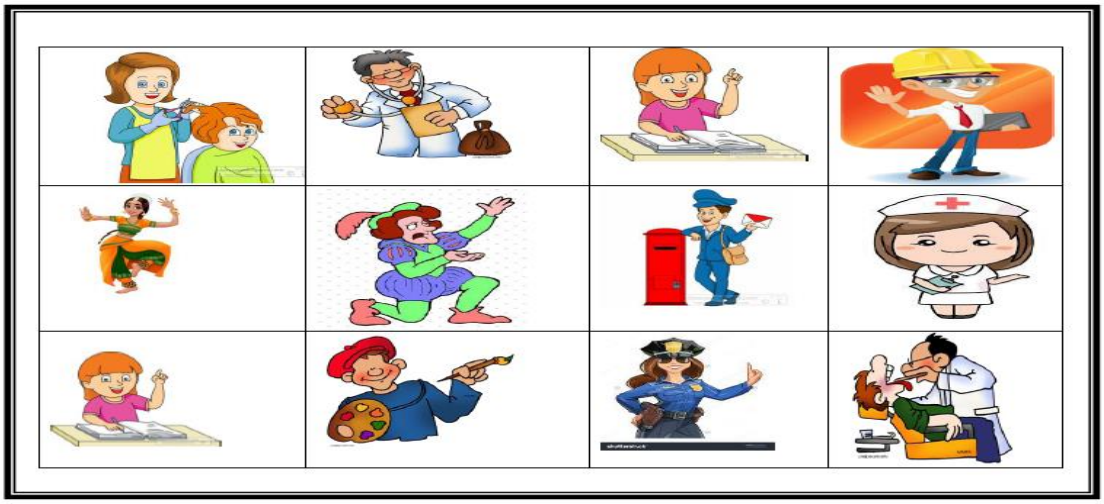

Figure 1. A Sample of Bingo Cards.

Diffirent gifts can be added to the surprise box. Gifts added in this game were;

- Motivating elements like smileys, stars, stamps,
- Stationery items (pen, eraser, sharpener, crayons, notebook, etc.),
- Food (Chocolate, candy, etc.).

Figure 2: A Picture of the Surpise Box Used in this Bingo Game.

Game Application Plan

Table 2

Game Application Plan

Time	Phases	Details of the Game Application Plan
Phase 1 (25 min)	**Pre test**	• Pretest is applied to measure the knowledge of the students.
Phase 2 (5 min)	**Explanatory Speech**	**Details of the Application** • Teacher gives an explanatory speech to the students in English in a simple way (why we are here, what we are going to do and how, etc.) • Teacher explains the objectives of the game, • Teacher emphasizes the importance of the goals, • Teacher presents the materials, • Attracts students' attraction to the materials.
Phase 3 (30 min)	**Application Phase**	• Teacher starts the PowerPoint presentation sentences that explain jobs. Students try to understand the job written in the sentence and also read by the teacher and if that job is on the bingo card of the student, he/she cover the job with a small sheet of paper. • Teacher continues to read the sentences one by one on the presentation, • If a student covers 4 jobs in a row, he/she raises his/her hand and shouts "Bingo". Then he/she tries to say the names of the jobs in the row correctly. If s/he knows the names correctly, s/he chooses a gift from the surprise box. • Each student who completes a row says "Bingo", then tries to say the names of the jobs to choose a gift from the surprise box

		• The first student to close all 12 jobs on his bingo card and succeed in saying the names gains a gift to be determined by the teacher.
Phase 4 (15 min)	**Post test**	• After all the students cover the jobs on their bingo cards, the game finishes. Then posttest is applied.
Phase 5 (25 min)	**Game Evaluation**	• To measure the effect of the game, students are asked to fill out a game evaluation form.
Total Time	The bingo game takes 100 minutes After the phase 1 and 3, there can be 10 minute break time.	
Materials	Bingo cards that include the pictures of 12 jobs for each student, 12 small pieces of paper, Surprise box, PowerPoint presentation of the jobs.	

Results

Pre-test and Post-test Results

The pre-test and post-test results of both experimental and control group students were given in Table 3 below. In the pre-test and post-test, 30 questions about jobs were asked to the students. As seen in Table 3, there was no significant difference between the pre-test and results of the students in both experimental and control groups (p= .806). It was seen that the groups had similar readiness levels at the beginning. According to the post-test results, the p value was measured as 0,000 and there was a significant difference between the post-test averages of the experimental and control groups in favour of the experimental group. Accordingly, it was seen that the bingo game had a positive effect on teaching the subject of "Jobs".

Table 3

Pre-test and Post-test Results of the Experimental and Control Groups

Pre-test Results						
Group				**t test**		
	N	$\bar{X}$	**SD**	**t**	**df**	**p**
Experimental	60	10.23	2.205	-.247	98.519	.806
Control	60	10.37	3.556			
Post-test Results						
Group				**t test**		
	N	$\bar{X}$	**SD**	**t**	**df**	**p**
Experimental	60	29.02	1.033	29.02	1.033	29.02
Control	60	21.65	2.231			

Whether the bingo game had a positive effect on the learning of the students in the experimental group, dual sample t-test results were given in the Table 4 below:

Table 4

t-test Results of the Pre-test and Post-test of the Experimental Group

Experimental Group	**N**	$\bar{X}$	**SD**	**t test**		
				t	**df**	**p**
Pre-test Results	60	10.23	2.205	-62.850	59	.000
Post-test Results	60	29.02	1.033			

The pre-test averages of the students in the experimental group (X=10.23) increased considerable in the post-test after the bingo game (X=29.02). As seen in Table 4 and since the significance value between the tests was measured as 0.000; it can be said that the bingo game had a positive effect on the learning of the students.

Attitudes of Students against Job Bingo Game

Scale Results: In the study, the scale of Akkuzu (2015), having a 0,800 Cronbach's Alpha reliability coefficient, was used in order to measure the attitudes of students towards the job bingo game. The scale consisted of 12 items. However, 2 items of the scale were removed and a total of 10 items were used in this research. The scale was applied immediately after the job bingo game. The reliability coefficient of the scale were measured again with the 10 items and Cronbach's Alpha reliability coefficient was measured as 0.708. Based on this result, it was concluded that the 10-item attitude scale applied was effective in measuring the attitudes of the students towards the job bingo game. More detailed information about the items of the scale was given in Table 5.

When Table 5 was examined, the average scores of the items in the scale were sorted according to the average size and starting from the highest to the lowest; item 1 with an average of 3.92; item 8 with an average of 3.85; item 10 with an average of 3.73. The low item average scores were sorted from lowest to highest; item 2 with an average of 3.03; item 3 with an average of 3.38 and item 7 with an average of 3.42.

Table 5

Scale Statistics

Item Number	Explanation	I Totally Agree		I Agree		I Disagree		I Totally Disagree		Average	Standard Deviation
		N	%	N	%	N	%	N	%	$\bar{X}$	Sd
1	I had fun while playing	55	91.7	5	8.3	-	-	-	-	3.92	.279
2	It was interesting	23	38.3	19	31.7	15	25.0	3	5.0	3.03	.920
3	The game helped me learn new words	29	48.3	26	43.3	4	6.7	1	1.7	3.38	.691
4	I had no difficulty in playing	44	73.3	14	23.3	2	3.3	-	-	3.70	.530
5	I would like to play this game for learning vocabulary	40	66.7	15	25.0	3	5.0	2	3.3	3.55	.746
6	The rules of the game were not complicated	44	73.3	13	21.7	3	5.0	-	-	3.68	.567
7	I could see my mistakes while playing	30	50.0	26	43.3	3	5.0	1	1.7	3.42	.671
8	I think the game was useful	51	85.0	9	15.0	-	-	-	-	3.85	.360
9	I would like this game to be used in the lessons	42	70.0	11	18.3	6	10.0	1	1.7	3.57	.745
10	It increased my desire to learn	47	78.3	10	16.7	3	5.0	-	-	3.73	.548

Considering the data in Table 5, it was seen that the students had high attitude scores in the items related to the facts that students had fun while playing; the game was a useful game and they had no difficulty in playing. It was seen that the attitude scores of the items related to the game's being interesting, helping them to learn new words and making them see their mistakes while playing were relatively lower than other item scores. Considering all these results, it could be said that the students generally had a positive attitude towards the job bingo game. Except for the second and third

items, more than half of the students answered other eight items as "I totally agree", which showed that the students had positive attitudes towards the game and they liked the job bingo game.

In the study, four open-ended questions were asked to the students in order to get their opinions about the job bingo game. In order to learn which parts students liked most in the job bingo game, they were asked *"What are your three favourite aspects of this game?"* The data in Table 6 below were obtained from their answers to this question.

Table 6

Answers of the Students to the First Question

Answers	**Students Who Answered**	**f**
Having prizes or gifts	s1, s2, s3, s4, s6, s8, s9, s10, s12, s13, s14, s15, s16, s17, s18, s20, s21, s22, s23, s24, s25, s27, s28, s30, s31, s32, s34, s36, s37, s38, s40, s41, s42, s43, s44, s45, s46, s47, s49, s50, s51, s52, s53, s54, s55, s56, s57, s58, s59, s60	**50**
Funny and Entertaining	s3, s6, s8, s10, s11, s13, s14, s16, s17, s19, s20, s22, s24, s26, s29, s39, s40, s42, s43, s44, s47, s48, s49, s51, s52, s54, s55, s56,	**28**
Instructive	s3, s4, s5, s6, 7, s9, s10, s11, s12, s19, s20, s23, s27, s32, s33, s44, s48, s49, s52, s53, s54, s55, s57, s59, s60	**25**
Learning "Jobs"	s1, s5, s18, s19, s22, s25, s28, s30, s31, s33, s34, s36, s37, s38, s43, s46,	**14**
Well prepared	ö1,ö4, ö6, ö10, ö23, ö26, ö34,	**7**
Reinforcing	s4, s20, s21, s25, s56, s57	**5**
Exciting	s7, s12, s26, s29, s51	**5**
Competitive	s27, s32, s39, s40, s59	**5**

50 students in the experimental group liked the job bingo game in terms of *"having prizes or gifts"* in the game. Participant S1 and S10 stated that *"the prizes were very good"* and the participant S50 stated that they liked the prizes in the game by saying *"I liked to earn gifts or prizes when I did bingo".* 28 students who thought that the job bingo game was *"funny and entertaining"* stated that they had fun while playing the game. One of the students, S53, said that *"we both play and learn, this is a very good advantage for us";* participant S3 stated that *"I had fun playing the game"* and *"the job bingo game was entertaining".* Among the 25 students stating that the bingo game was *"instructive",* the participant S11 expressed his views on the job bingo game by saying *"It helped me understand the jobs better"* and the participant S54 said *"it helped me learn new words".* There were 14 students who thought that the best part of the game was *"learning jobs".* The participant S19 emphasized the learning of jobs in the bingo game by saying "*it became more entertaining as it was*

about jobs" and the participant S22 said *"we learn jobs by playing bingo game".* In addition, 7 students emphasized that the job bingo was *well prepared;* 5 students stated that the game was *reinforcing, exciting* and *competitive.*

Secondly, students were asked to compare the lessons with games and lessons without games. By asking this question, researches wanted to learn the thoughts of the students especially about the lessons with games. The data obtained from the students were listed below in two separate tables as lessons with games and lessons without games.

Table 7

Answers of the Students to the Features of the Lessons with Games

Answers	**Students Who Answered**	**f**
Entertaining	s1, s2, s3, s4, s5, s6, s7, s8, s11, s12, s13, s14, s15, s16, s17, s18, s19, s21, s22, s23, s24, s25, s26, s27, s28, s29, s30, s31, s32, s33, s35, s37, s39, s40, s41, s42, s43, s44, s45, s46, s47, s48, s51, s53, s54, s55, s56, s57, s58, s60.	**50**
Instructive	s2, s3, s4, s6, s7, s8, s9, s10, s11, s12, s14, s15, s18, s19, s21, s23, s25, s26, s27, s28, s30, s31, s32, s34, s36, s37, s38, s39, s42, s44, s46, s48, s49, s50, s51, s52, s53, s54, s55, s56, s58, s59	**42**
Nice	s14, s17, s20, s21, s22, s23, s24, s26, s30, s31, s33, s34, s35, s38, s41, s42, s45, s46, s49, s51, s53, s54, s57, s58, s60	**25**
Elating	s12, s15, s16, s24, s40, s43, s47, s48, s49, s50, s52	**11**
Exciting	s3, s7, s17, s18, s22, s23, s27, s30	**8**
Time Passes Quickly	s3, s19, s27, s29, s33, s44,	**6**
Memorable	s7, s55, s58, s59, s60	**5**

As seen in Table 7, 50 of the students said that the lessons with games were *"entertaining";* 42 of them said that lessons with games were *"instructive"* and helped them understand and learn better; 25 of them said that such lessons were *"nice";* 11 of them stated that the lessons with games were *"elating";* 8 of them were more "*excited"* in the lessons with games; 6 of them said that *"the time passed quickly"* in these lessons and 5 of them stated that lessons with games were more *"memorable".*

Answers of the students about the lessons without games were given in Table 8 below. 38 students stated that lessons without games were *"boring"*; 21 students thought that the lessons without games were *"not fun"* and they could not learn better when the lessons were not fun; 17 students said that they could not learn better in such lessons as they thought that lessons were *"uninstructive";* 13 students said that the lessons without games were *"bad"* and *"hard to learn".*

Students also stated that lessons without games were *"not memorable", "tiring", "and unmemorable"* and they "*made them* unhappy".

Table 8

Answers of the Students to the Features of the Lessons without Games

Answers	**Students Who Answered**	**f**
Boring	s2, s3, s6, s8, s10, s11, s12, s13, s15, s16, s17, s19, s22, s24, s25, s26, s27, s29, s31, s32, s33, s34, s35, s36, s39, s40, s41, s43, s44, s45, s46, s48, s50, s51, s55, s57, ö59, s60	**38**
Not Fun	s2, s4, s5, s8, s12, s13, s18, s19, s21, s23, s26, s28, s29, s30, s32, s33, s34, s39, s47, s52, s54	**21**
Uninstructive	s2, s3, s6, s7, s8, s9, s10, s11, s14, s18, s19, s20, s23, s38, s42, s46, s54	**17**
Bad	s14, s17, s22, s23, s30, s31, s34, s46, s48, s49, s51, s54, s58,	**13**
Hard to learn	s15, s18, s25, s30, s31, s38, s51, s52, s55, s56, s57, s59, s60.	**13**
Unmemorable	s20, s55, s57, s58, s59, s60.	**6**
Tiring	s13, s16, s17, s39, s43	**5**
Making Unhappy	s15, s24, s43, s47	**4**

Thirdly, students were asked *"Have you learned more easily with this game?"*. All the students answered "Yes" to this question and stated that the bingo game helped their learning. Students also stated their reasons on how the bingo game affected their learning. The explanations of the students were given in Table 9 below:

Table 9

Answers of the Students to the Third Question

Answers	**Students Who Answered**	**f**
Yes	All of the 60 students	**60**
It helped me learn more easily	s1, s2, s3, s4, s5, s7, s8, s10, s11, s12, s13, s14, s16, s18, s20, s22, s23, s24, s26, s28, s29, s30, s31, s33, s34, s36, s39, s42, s44, s46, s48, s57, s58, s60	**34**
I learned with fun	s8, s9, s11, s12, s15, s25, s26, s31, s32, s35, s40, s41, s45, s47, s51, s52, s54, s56, s57, s59	**20**
I learned new words	s13, s16, s17, s19, s21, s27, s28, s49, s54	**9**
It was more memorable	s6, s7, s37, s55, s59	**5**
I liked learning with games.	s9, s39, s43, s50, s53	**5**

Table 9 showed that job bingo game had a positive effect on students' learning. 34 students stated that *"the bingo game helped them learn more easily"*; 20 of them said that *"they learned with fun";* 9 students stated that *"they learned new words";* and lastly 5 students each stated that *"the game was more memorable"* and *"they liked to learn with games".*

In order to find out what the students think and whether any changes should be made in the game, *"In your opinion, should the game be changed? If yes, write with reasons"* question was asked to the students. Answers of the students were given in Table 10 below:

While 7 students thought that the game should have been changed, 53 students thought that there was no need to make any changes in the job bingo game. According to Table 10, 7 students thought that changes were necessary; 4 students wanted the gifts to be changed, 2 students wanted less words, 1 student wanted more words and 1 students wanted more gifts. 53 students thought that there were no changes needed. These students thought that the game was beautiful as it was (n=20), it was fun (n=11), it was well-prepared (n=9), there was nothing to add (n=9) and the game was instructive (n=5).

Table 10

Answers of the Students to the Fourth Question

Answers	**Students Who Answered**	**f**
Yes, it should	s4, s7, s9, s12, s13, s43, s46	**7**
Gifts could be different	s4, s7, s12, s43	**4**
There should have been less words	s9, s31	**2**
There should have been more words	s12, s13	**2**
There should have been more gifts	s13	**1**
There should have been gifts for every bingos.	s46	**1**
No, It should not		**53**
It is beautiful as it is	s1, s2, s15, s18, s22, s24, s26, s27, s30, s36, s37, s40, s42, s47, s49, s52, s56, s57, s58, s60	**20**
It was fun	s8, s11, s16, s20, s23, s24, s25, s48, s50, s53, s56	**11**
It was well-prepared	s3, s11, s17, s19, s32, s33, s41, s55, s59	**9**
There was nothing to add	s18, s23, s35, s37, s39, s40, s45, s48, s54	**9**
It was instructive	s11, s14, s25, s39, s50	**5**

Teacher's Opinions about the Job Bingo Game: The semi-structured interview with the teacher included 9 questions. The researchers aimed to find different perspectives of the teacher, who observed the students from the beginning to the end of the game, about the bingo game by asking these questions. Open-ended questions were prepared to get the teacher's views on the game.

First of all, *"How were the motivations of the students"* question was asked to the teacher. As a reply to this question, he said, *"When I told the students that we were going to play bingo, they all shouted 'Yay!' in unison. Then, I explained the rules of the game stating that the game was adapted to jobs and different from the bingo game we knew. Each student drew their own bingo cards without looking at the front of the page. They started the game with great enthusiasm. Students were very happy while playing. They were eager to pull their gifts out of the surprise box when they did the first bingo, especially when they closed jobs on their bingo cards one by one. Students carefully followed the explanations of the jobs on the screen and concentrated on the game with determination to finish the game first. It was a very enjoyable game"* and stated that the students were pleasant and excited from the beginning to the end of the bingo game.

When asked *"Was the job bingo game suitable with students' level?"* to check whether the game was suitable for their level, the teacher said *"Since the bingo game was a game students played with their families, they quickly adapted to the game without having any trouble understanding the rules. Although some students had difficulty in understanding the job in the pictures, they managed to find the right one when they focused a little more. In my opinion, the job bingo game was a suitable game for their level in terms of its being about jobs which was included in the curriculum of fourth grade in primary school"* and stated that game was suitable for their level.

Then, *"Do you think the game was effective for vocabulary acquisition?"* was asked to the teacher to learn the effect of the game on students' vocabulary acquisition. The teacher answered *"In the job bingo game, every student got a bingo card having pictures of 12 different jobs. As the game included a total of 30 jobs, the pictures of the jobs on each student's card were mostly different. Students tried to keep their pronunciation in mind by listening to the explanation of the job carefully, as they knew they had to count the names of the jobs correctly in order to win a gift. Except for a few students, all the students who did bingo were able to count the names of the jobs at that time"* and stated that the topic chosen for the game attracted the attention of the students, so that they learned more easily in the acquisition of the target words.

Next, *"Would you use this bingo game for vocabulary acquisition?"* question was asked to the teacher. In response to this question, he said *"The job bingo game increased students' interest in the lesson. Therefore, I can adapt the bingo game to lessons in different subjects and classes."* And stated that this game could also be used in teaching vocabulary.

Following that, *"Do you think the game has changed the classroom atmosphere?"* question asked to find out whether the game had any positive or negative effects on the classroom atmosphere. The teacher said *"I can say that it definitely has. During the bingo game, all of the students focused on the pictures of the jobs on their bingo cards and were eagerly awaiting when their jobs would appear on the screen. The possibility of winning a surprising gift if the jobs were pronounced correctly in the first bingo also aroused the students' curiosity. While the first student making bingo was pulling his gift card out of the surprise box, I felt the gaze of many students wishing to be in that student's position. The students who could not count the jobs in the first bingo were given another chance to receive surprise gifts by counting the names of the jobs correctly when one of the other two rows were completed. They were determined to keep the names of the jobs in their mind and pronounce them correctly to receive the gifts"* and stated that the game allowed them to have fun and learn while having fun.

Then, *"How did the first and last finishers act during the game?"* question was asked to the teacher. He said *"All the students enjoyed the game. Especially at the beginning of the game, they were curious about which of their friends would do bingo first and receive the surprise gift. All the other students looked at the first bingo student enviously. I could clearly see the desire in their eyes. As the bingo game continued, students started to do the bingo one by one and received their gifts. However, the students, who could not do bingo because of not completing a row in their bingo cards, started to become even more impatient. But fortunately, towards the end of the game, they were able to close their jobs and do their bingos. The student who finished first in the game was so happy. He kept jumping happily until the end of the game saying "I won". Actually, we did not make a ranking as first, second or third in the game, but since the students were in competition with each other, I did not want to overshadow their joy, they had fun and were happy" and* stated that especially the students who finished early were much happier and they acted like as if they won the race.

Next, *"How were the students' attitudes towards the game?*" was asked to the teacher to learn the positive-negative attitudes of the students towards the game. As a reply to this question, he said *"The students had no difficulty in adapting to the game as they were familiar with the bingo game.*

Only some students who saw that there were some jobs they did not know before on the bingo card were a little uneasy, but they got used to playing when they started to find the jobs in their boards. And also they wanted to play one more time when the game finished, which meant a lot for me" and stated that students did not have difficulty in playing the job bingo game similar to the bingo game they were familiar with and they only had some difficulties in finding some of the jobs they did not know.

Lastly, *"Do you think the game affected students' exam results positively?"* was asked to the teacher to find out whether the game had any positive or negative results on the exam results of the students. The teacher said *"While the students were playing the bingo game, they started to learn the names of the jobs one by one without realizing it. In the pre-test applied before game started, many students said that they did not understand the questions and they answered them without knowing the answers, and it took a little longer for them to finish the test. However, at the end of the game, the pre-test was applied as a post-test. Students solved the questions more quickly and confidently and the results of the post-test showed that they understood the subject"* and stated that though students had some difficulties while solving the pre-test, they did not have difficulty in the post-test after the job bingo game and they were more successful in the post-test than pre-test.

Discussion and Conclusion

According to the results of the research, the student both enjoyed and learned the "jobs" more easily with the job bingo game. The significant relationship between the pre-test results and post-test results showed that the game had a positive effect on students' learning. This result supports many previous studies on the effect of games on learning English (Işık and Semerci, 2016; Dervişoğulları, 2008; Kalaycıoğlu, 2011; Demirci, Hamzaçebioğlu and Arslan, 2021; Demirci and Olur, 2018; Demirci and Çınar, 2022; Tosuncuoğlu, 2014; Kocaman and Cumaoğlu, 2014; Bulut and Boz, 2016; Akkuzu, 2015).

In the study, it was seen that students had a positive attitude towards the bingo game and it was concluded that their success increased concordantly. Students playing the job bingo game thought that the game was fun, instructive and catchy; they had fun while playing game and learned while having fun. This result supported the studies of 'Coco et al. (2001)' and 'Wahyuni and Syafei (2016)'. Wahyuni and Syafei (2016), who studied the bingo game, stated that the bingo game motivates students during the learning phase and it would be beneficial to use it especially in vocabulary

teaching (Wahyuni and Syafei, 2016). Based on these findings, it was concluded that it would be beneficial to use educational games while teaching vocabulary in a foreign language.

As a result, considering both the pre-test and post-test results of the students, the data obtained from the game evaluation questionnaire, the data obtained from the attitude scale, and the opinions obtained from the teacher participating in the research, the professional bingo game "Jobs" in the 4th grade curriculum was positively effective in the teaching of the subject, and after the game, the students were more willing and motivated, and because they saw what they learned while having fun, they were more willing to teach with the game. It is thought that by adapting the said bingo game to different subjects, it can be used in teaching vocabulary and it will affect learning positively.

The results of the study showed that the job bingo game helped the lesson be more enjoyable and easy to understand. The results showed that the game had a positive effect on students' learning. These results support many previous studies on the effect of games on learning English (Işık and Semerci, 2016; Dervişoğulları, 2008; Kalaycıoğlu, 2011; Demirci, Hamzaçebioğlu and Arslan, 2021; Demirci and Olur, 2018; Demirci and Çınar, 2022; Tosuncuoğlu, 2014; Kocaman and Cumaoğlu, 2014; Bulut and Boz, 2016; Akkuzu, 2015).

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Recommendations

Based on these findings of this research, it was concluded that it would be beneficial to use educational games while teaching vocabulary in a foreign language. As the students both enjoyed the game activity and learned more easily, it is suggested that lessons can be more enjoyable when more audio-visual materials and game activities are used. By doing so, it will enable students to participate actively in the learning – teaching process. It should be taken care to ensure these games and materials are appropriate for the levels of the students and achivements, and that they will arouse students' curiosity and attract their attention. Classroom and branch teachers should be trained on preparing materials and games that will attract students' attention in lessons.

In-service training should be given to the teacher on what the game learning approach is and how it can be used in lessons. Additionally, students and parents should be informed about this approach. It should not be forgotten that the more fun and attractive the lessons are, the more effective learning will be.

The number of experimental studies on the game learning approach in our country is few. With this study, an exemplary application of the game learning approach was made and positive changes were observed in students' attitudes and achievements towards the game activity. Activities similar to this study should be carried out in different schools, education levels and different lessons.

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References

Akkuzu, M. (2015). *A game-based application on english vocabulary acquısıtıon: A case study in the efl context* (Unpublished doctoral dissertation). Ortadoğu Teknik University, Ankara.

Bulut H., & Boz, İ. (2016). Oyunla öğretim yönteminin 4. sınıflarda akademik başarıya etkisi. *International Journal of Early Childhood Education Research, 1*(1), 61-75.

Coco, A., Woodward, I, Shaw, K., Cody, A., Lupton, G., & Peake, A. (2001). Bingo for beginners: A game strategy for facilitating active learning. *Teaching Sociology, 29(*4), 492-503.

Demirci, C., & Çınar, S. O. (2022). Use of educational games with recycled materials in english teaching. *European Journal of Education Studies, 9*(1), 29-43.

Demirci, C., Hamzaçebioğlu, H., & Arslan, M. (2021). The effects of "Eat up" game on english teaching. *European Journal of Education Studies, 8*(1), 20-31.

Demirci, C., & Olur, H. (2018). Effects of educational 'My monster' game on teaching in primary schools of Turkey. *European Journal of Education Studies, 4*(3), 243-259.

Dervişoğulları, N. (2008). *Yabancı dil olarak Türkçe öğretilen sınıflarda oyunlarla sözcük öğretimi*. (Unpublished master's thesis). Ankara University, Ankara.

Foulqiue, P. (1994). *Pedagoji sözlüğü*. İstanbul: Sosyal Publishing.

Güneş, F. (2015). Oyunla öğrenme yaklaşımı. *Turkish Studies, 10*(11), 773-786.

Işık, İ., & Semerci N. (2016). İlkokul 3. sınıf öğrencilerine İngilizce kelime öğretiminde eğitsel oyunların akademik başarıya etkisi. *Çankırı Karatekin Üniversitesi SBE Dergisi, 7*(1), 787-804.

Kalaycıoğlu, H. E. (2011). *The effect of picture vocabulary games and gender on four year-old children's english vocabulary performance: An experimental investigation*. (Unpublished master's thesis). Middle East Technical University, Ankara.

Kara, M. (2010). Oyunlarla Türkçe'nin yabancı dil olarak öğretimi. *Türklük Bilimi Araştırmaları Dergisi, (27),* 407 - 421.

Karasar, N. (2005). *Bilimsel araştırma yöntemi.* Ankara: Nobel Publishing.

Kocaman, O., & Cumaoğlu, G. K. (2014). Eğitsel yazılım (DENIS) ve oyunlarla İngilizce kelime öğretiminin kelime öğrenme stratejilerine ve başarıya etkisi. *Eğitim ve Bilim, 39*(176), 305-316.

MoNE (Ministry of National Education). (2014). Çocuk gelişimi ve eğitimi, oyun etkinliği – 1. Milli Eğitim Bakanlığı, Ankara.

Nicolopoulou, A. (1993). Play, cognitive development, and the social World: Piaget, Vygotsky, and Beyong. *Human Development, 36,* 1-23.

Özgenç, N. (2010). *Oyun temelli matematik etkinlikleriyle yürütülen öğrenme ortamlarından yansımalar.* (Unpublished master's thesis). Karadeniz Teknik University, Trabzon.

Piaget, J. (1952). *Play, dreams and imitation in childhood.* W. W. Norton, & Co.

Ramazan, O. (2013). *Oyun etkinlikleri II. Çocuk ve oyun* (Ed. R. Zembat), Erzurum: Atatürk Üniversitesi Açık Öğretim Fakültesi Yayını.

Tosuncuoğlu, İ. (2014). İngilizce kelimelerin oyunlarla öğretilmesi. *Journal of History Culture and Art Research, 2*(4), 140-146.

Tural H. (2005). *İlköğretim matematik öğretiminde oyun ve etkinliklerle öğretimin erişi ve tutuma etkisi.* (Unpublished master's thesis). Dokuz Eylül University, İzmir.

Ülküdür, M. A., & Bacanak, A. (2013). Proje tabanlı öğrenme etkinlikleri ile oyun tabanlı öğrenme etkinliklerinin hazırlık (geliştirilme) boyutunda karşılaştırılması. *Bayburt Eğitim Fakültesi Dergisi, 8(*1), 21-43.

Wahyuni, D., & Syafei, A. F. R. (2016). The use of action bingo game in teaching vocabulary to elementary students. *Journal of English Language Teaching, 5*(1), 163-168.