Educational Research Association
The International Journal of Research in Teacher Education
2022, 13(3): 27-37
ISSN: 1308-951X

http://www.eab.org.tr

http://ijrte.eab.org.tr

Innovative Thinking Tendencies of Middle School Students in the Light of Different Variables*

Nur AKCANCA[1]

Abstract

Adapting to today's world which is in constant change is directly related to the adoption of an innovative understanding. Gaining this innovative perspective also constitutes the primary aim of education. Developing innovative thinking skills of students, especially at their early ages, is also considered important to shape their future lives. In order to develop these mentioned skills, first of all, it is necessary to determine the current innovative thinking tendencies of the students and to clearly reveal their relationship with different variables. Starting from this point of view, the aim of this study was settled as determining the innovative thinking tendencies of middle school students and revealing their relationship with different variables. This study that corresponds with the survey model was conducted with 356 middle school students (5th-8th grades). Innovative Thinking Tendency Scale was used as a data collection tool in the research. The sub-dimensions of the scale are innovative self-efficacy, openness to innovation, innovative problem solving, innovative perseverance and innovative group leadership. Mann Whitney-u and Kruskal Wallis tests, which are from non-parametric tests, were used in the analysis of the data. As a result of the research, while no significant difference was detected between students' innovative thinking tendencies and sub-dimensions, gender, grade level, and students' receiving awards; significant differences were found between the number of siblings, family income levels and academic grade point averages. In addition, it is among the results obtained from the research that students' innovative thinking tendencies are at a moderate level. Within the scope of the results obtained from the research, it is recommended to compare the educational experiences to be carried out with different teaching techniques and methods in order to constantly renew the educational conditions and to support the innovative thinking tendencies of the students.

Keywords: Innovative thinking skills, innovative thinking tendencies, middle school students.

* A brief summary of this study was presented at the 5th International Symposium of Limitless Education and Research (ISLER 2021).

[1]Associate professor, Çanakkale Onsekiz Mart University, Turkey, ORCID ID: 0000-0003-4074-0639
Correspondence Email: nurakcanca@comu.edu.tr

Introduction

Rapid developments in science and technology have made it imperative for individuals to have different skills to be successful. In this imperativeness, keeping up with the times and following innovations closely is seen as an important step in improving themselves (Oktuğ & Özden, 2013; Aydemir, 2021). Only through this way, they can turn into creative and problem-solving individuals and have their places among the societies that lay the foundations of innovative thinking (Wisetsat & Nuangchalerm, 2019). For this reason, expectations of societies from education have also changed.

Education needs to embark on the development of innovative thinking mentality as its primary goal. It is aimed to raise generations as individuals who can adapt to changing living conditions and contribute to the future by taking certain measures as educational reforms both in national and international sense (Muradoğlu, 2020). In the international sense, the concepts of creativity and innovation stand out among the 21st century skills revealed in the report of the Partnership for 21st Century Skills (P21). In the national sense, in recent years, the process of creating innovation has been started by switching to the constructivist education model in the primary and secondary school education system (Taş, 2017). As a result of aiming to gain entrepreneurship, engineering and design skills and innovative thinking skills, important steps have been taken in raising individuals equipped with 21st century skills (MEB, 2018; Koştur, 2019). The emphasis on the development of innovative thinking, both in national and international sense, is remarkable (Deveci & Kavak, 2020).

It is thought that innovation which is a very important concept for countries can be scrutinized in four different ways. First of them is the process of offering new and authentic options to the traditional learning strategies. Another can be thought as the tendency for realizing individual potential. Activating the power of creative thinking is seen as the third step of innovation. At last, attention is drawn to the realization of all types of intellectual activities in the active creative thinking process (Mykhailyshyn, Kondur, & Serman, 2018). With this research, it is aimed to address the individual potential of innovation, which is the second expression of innovation in education.

To integrate the innovation skills of individuals that are aimed to be developed through education into daily life is also highly important. Innovation thinking skills that are used in life will also be effective in raising life standards of individuals (Koçak, 2018). It is necessary to be able to associate the innovation process with life, such as adapting to the changes taking place in life, being open to different views and thoughts, being extroverted, being exploratory and extracting new opportunities from problems (Adıgüzel, Kaya, Balay, & Göçen, 2014; Johnston & Bate, 2003). Acquiring the mentioned skills at an early age will increase the potential of individuals in terms of how they will approach the problems they will encounter in their future lives, how they will come up with ideas in finding a solution and how they will apply these ideas (Deveci & Kavak, 2020). From this point of view, determining the innovative thinking perceptions of young students can give an idea to teachers in terms of activating different methods and techniques. It is also thought that this kind of a study is important for evaluating students' innovative thinking skills and determining which variables have an impact on these perceptions. Looking at the researches, it is seen that there are studies conducted with secondary school students (Aras, 2020; Gök, 2021; Deveci & Kavak, 2020; Muradoğlu, 2020; Şanlı, 2020). Gök (2021) examined the effect of the education module she designed in her research on students' innovative thinking tendencies. Şanlı (2020) examined secondary school textbooks in the context of innovative thinking with the document review method in his research. Muradoğlu (2020), on the other hand, focused on determining the innovativeness perceptions and innovativeness indicators of secondary school students in her research. Aras (2020) tried to determine the innovative thinking levels of secondary school students in terms of different variables, and unlike this research, the Innovative Thinking Scale developed by the researcher was preferred. Deveci and Kavak (2020), on the other hand, developed the Innovative Thinking Tendency Scale, which was also used in this study, in order to determine the innovative thinking tendencies of secondary school students. Looking at the studies, it is understood that the studies conducted with secondary school students are limited. From this point of view, it is thought that in this study it is important to determine the innovative thinking tendencies of secondary school students and to reveal their relationship with different variables.

Aim of the Study

The aim of the study was to determine the innovative thinking tendencies of secondary school students and to reveal their relationship with different variables. Within the framework of this purpose, answers to the following questions were sought;

1. What is the level of students' innovative thinking tendencies?
2. Is there a significant difference between students' innovative thinking tendencies and different variables such as their gender, grade level, academic grade point average, award status, number of siblings and income levels?

Method

This research, which examines students' innovative thinking tendencies and their relationship with different variables, was designed in a survey model. In this model, which aims to reveal the current situation as it is, the relationship between the situation and different variables is also tried to be revealed (Karasar, 2022).

Participants

356 secondary school students (5th – 8th grades) participated the study voluntarily.

Table 1. Sociodemographic Attributes of Participants

Gender	*5th grade*	*6th grade*	*7th grade*	*8th grade*
Girl	47	33	55	61
Boy	55	22	63	20
Total	102	55	118	81

In Table 1, it appears that 102 5th grade students, 47 girls and 55 boys, 55 6th grade students, 33 girls and 22 boys, 118 7th grade students, 55 girls and 63 boys, 81 8th grade students, 61 girls and 20 boys, participated in the study.

Data Collection Tool

"Innovative Thinking Tendency Scale" developed by Deveci and Kavak (2020) was used as a measurement tool in the research. The sub-dimensions of the 25-item "Innovative Thinking Tendency Scale" consist of 8 items of innovative self-efficacy, 6 items of openness to innovation, 5 items of innovative problem solving, 3 items of innovative perseverance and 3 items of innovative group leadership. The scale was prepared in a five-point Likert type (Strongly Disagree, Disagree, Undecided, Agree, Totally Agree). The Cronbach reliability coefficient was calculated as 0.91. In this study, this value was found to be 0.95.

Data Collection and Analysis

After the process of getting necessary permissions for data collection, students were informed about the process with the permission of school administration and teachers. It was mentioned about the aim of the study, that no scoring would be made and that the data would be used for scientific purposes. Students were asked to answer the statements sincerely and reminded not to leave any blanks items.

Collected data were analyzed using SPSS 21.0 statistical packaged software. Normality assumptions of the data were made at the decision stage of the test to be used in the analysis of the data. At this framework, it was found out that the data did not show a normal distribution. For this reason, Mann Whitney-u and Kruskal Wallis tests, which are non-parametric tests, were preferred in the analysis of the data. The average scores and standard deviation values of the secondary school students participating in the study from the overall scale and its sub-factors were tried to be explained with tables.

The average scores of students' innovative thinking dispositions as low, medium and high were determined according to the plus-minus 0.5 standard deviation (X±0.5xSs) criterion (Çamlıbel Çakmak, 2012). According to this calculation, scores of 85 and below are low; scores between 86-106 are moderate; scores of 106 and above were calculated as high level.

In addition, the relationship between the scores of secondary school students in the sub-factors of innovative self-efficacy, openness to innovation, innovative problem solving, innovative perseverance and innovative group leadership with the determined independent variables was examined. The total innovative thinking tendency score obtained from the scale and the scores for the sub-dimensions, respectively, were also determined. While the lowest score that can be obtained from the overall scale is 25, the highest score is determined as 125.

Results

This chapter includes findings obtained from the statistical analysis of the data collected from the research.

The average scores and standard deviation values of innovative thinking tendencies of secondary school students participating in the study were examined. Statistical data showing students' innovative thinking tendencies is shown in Table 2.

Table 2. Statistical Data Showing Students' Innovative Thinking Tendencies

	N	*Highest Score*	*Lowest Score*	$\bar{x}$	*Sd*
Innovative Thinking Tendencies	356	125	6	96,58	19,26

In Table 2, it is seen that the mean values calculated over the total score obtained by the students from the scale of innovative thinking tendency are $\bar{x}$=96.58.12, standard deviation values Sd=19.26. Considering the innovative thinking average scores of the students, it is seen that this value is at a moderate level.

The Mann Whitney-u test results of the total and sub-factor scores of students' innovative thinking tendencies according to gender variable are given in Table 3.

Table 3. Students' Innovative Thinking Tendencies According to Gender Variable

Factors	*Gender*	*N*	*Rank Average*	*Rank Total*	*u*	*p*
Innovative Self-efficacy	Girl	196	180,57	35392,0	15274,0	,673
	Boy	160	175,96	28154,0		
Openness to Innovation	Girl	196	179,99	35278,0	15192,0	,683
	Boy	160	175,55	27912,0		
Innovative Problem Solving	Girl	196	183,27	35921,0	14549,0	,280
	Boy	160	171,50	27269,0		
Innovative Perseverance	Girl	196	184,24	36110,5	14359,5	,200
	Boy	160	170,31	27079,5		
Innovative Group Leadership	Girl	196	172,26	33763,5	14457,5	,239
	Boy	160	185,07	29426,5		
Total	Girl	196	181,28	35531,5	15134,5	,572
	Boy	160	175,09	28014,5		

In Table 3, it is seen that students' innovative thinking tendencies (u=15134.5; p>.05) and sub-dimensions do not differ significantly by gender. Looking at the average scores, it is seen that the innovative thinking tendencies of female students are higher than male students. When examined on the basis of sub-factors, it is seen that the average scores of male students in the innovative group leadership sub-dimension are higher.

The Kruskal Wallis test results of the total and sub-factor scores of innovative thinking tendencies according to the grade level of the students are given in Table 4.

Table 4. Innovative Thinking Tendencies of The Students According to the Grade Level

Factors	*Grade Levels*	*N*	*Rank Average*	X^2	*p*
Innovative Self-efficacy	5th Grade	102	177,04	,972	,808
	6th Grade	55	183,94		

	7th Grade	118	183,09		
	8th Grade	81	169,96		
Openness to Innovation	5th Grade	102	167,07	1,796	,616
	6th Grade	55	184,17		
	7th Grade	118	179,75		
	8th Grade	81	185,05		
Innovative Problem Solving	5th Grade	102	175,09	1,149	,765
	6th Grade	55	191,49		
	7th Grade	118	175,18		
	8th Grade	81	176,58		
Innovative Perseverance	5th Grade	102	170,35	2,533	,469
	6th Grade	55	196,44		
	7th Grade	118	178,97		
	8th Grade	81	173,72		
Innovative Group Leadership	5th Grade	102	185,53	1,482	,686
	6th Grade	55	170,58		
	7th Grade	118	171,62		
	8th Grade	81	182,77		
Total	5th Grade	102	177,85	,328	,955
	6th Grade	55	185,56		
	7th Grade	118	177,62		
	8th Grade	81	175,80		

When the Kruskal Wallis test results in Table 4 are examined, it has been determined that there is no significant difference between the students' innovative thinking tendencies (X^2=.328; p>0.05) and sub-dimensions and the grade level variable.

The Kruskal Wallis test results of the total and sub-factor scores of innovative thinking tendencies according to the academic grade averages of the students are given in Table 5.

Table 5. Innovative Thinking Tendencies of The Students According to the Academic Grade Averages

Factors	*Academic Grade Average*	*N*	*Rank Average*	X^2	*p*
Innovative Self-efficacy	70 and below	55	142,56	12,681	,005
	between 71-80	61	166,67		
	between 81-90	92	177,16		
	between 91 and 100	148	197,56		
Openness to Innovation	70 and below	55	144,58	7,717	,052
	between 71-80	61	173,91		
	between 81-90	92	183,63		
	between 91 and 100	148	188,38		
Innovative Problem Solving	70 and below	55	150,78	9,289	,026
	between 71-80	61	173,79		
	between 81-90	92	168,17		
	between 91 and 100	148	195,78		
Innovative Perseverance	70 and below	55	158,74	3,602	,308
	between 71-80	61	172,93		
	between 81-90	92	176,23		
	between 91 and 100	148	188,22		
Innovative Group Leadership	70 and below	55	120,25	24,005	,000
	between 71-80	61	181,07		
	between 81-90	92	175,28		
	between 91 and 100	148	199,50		
Total	70 and below	55	132,40	16,475	,001
	between 71-80	61	172,72		
	between 81-90	92	178,76		
	between 91 and 100	148	197,85		

In Table 5, a significant difference was found between students' innovative thinking tendencies and their academic grade averages (X^2=16.475; p<0.05). While a significant difference was detected between the scores of the students in innovative self-efficacy, innovative problem solving and innovative group leadership sub-dimensions and their academic grade averages (p<0.05). It was determined that there was no significant difference in the sub-dimensions of openness to innovation and innovative perseverance (p>0.05). Considering the average scores, it is seen that when the academic grade averages of the students increase, the innovative thinking tendency scores also increase.

The Mann Whitney-u test results of the innovative thinking tendency scores of the students according to the award status are given in Table 6.

Table 6. Innovative Thinking Tendencies of Students According to Their Award Status Variable

Factors	*Award Status*	*N*	*Rank Average*	*Rank Total*	*u*	*p*
Innovative Self-efficacy	Yes	127	187,29	23785,5	13425,5	,229
	No	229	173,63	39760,5		
Openness to Innovation	Yes	127	186,30	23660,0	13424,0	,252
	No	229	173,38	39530,0		
Innovative Problem Solving	Yes	127	182,04	23119,0	13965,0	,578
	No	229	175,75	40071,0		
Innovative Perseverance	Yes	127	186,91	23738,0	13346,0	,218
	No	229	173,04	39452,0		
Innovative Group Leadership	Yes	127	189,89	24116,0	12968,0	,101
	No	229	171,38	39074,0		
Total	Yes	127	188,57	23948,5	13262,5	,169
	No	229	172,91	39597,5		

In Table 6, it is seen that students' innovative thinking tendencies (u=13262.5; p>.05) and sub-dimensions do not differ significantly according to their status of receiving awards. Considering the average scores, it is seen that the innovative thinking tendencies of the award-winning students are higher than the students who did not receive any awards.

The Kruskal Wallis test results of the innovative thinking tendency scores of the students according to the number of siblings are given in Table 7.

Table 7. Innovative Thinking Tendencies of the Students According to Their Number of Siblings

Factors	*Number of Siblings*	*N*	*Rank Average*	*X^2*	*p*
Innovative Self-efficacy	Only child	15	145,50	12,921	,024
	2 siblings	138	182,44		
	3 siblings	124	162,23		
	4 siblings	55	207,09		
	5 siblings	14	163,61		
	6 siblings and more	10	239,05		
Openness to Innovation	Only child	15	167,40	10,680	,058
	2 siblings	138	180,97		
	3 siblings	124	161,45		
	4 siblings	55	205,39		
	5 siblings	14	159,75		
	6 siblings and more	10	231,35		
Innovative Problem Solving	Only child	15	159,53	20,975	,001
	2 siblings	138	182,11		
	3 siblings	124	154,67		
	4 siblings	55	203,87		
	5 siblings	14	187,11		
	6 siblings and more	10	281,00		

Innovative Perseverance	Only child	15	157,73	12,456	,029
	2 siblings	138	182,79		
	3 siblings	124	158,26		
	4 siblings	55	205,55		
	5 siblings	14	178,50		
	6 siblings and more	10	232,90		
Innovative Group Leadership	Only child	15	161,73	11,212	047
	2 siblings	138	194,41		
	3 siblings	124	158,00		
	4 siblings	55	181,72		
	5 siblings	14	161,46		
	6 siblings and more	10	224,60		
Total	Only child	15	145,27	17,599	,003
	2 siblings	138	186,17		
	3 siblings	124	156,41		
	4 siblings	55	206,70		
	5 siblings	14	169,82		
	6 siblings and more	10	253,50		

Considering the Kruskal Wallis test results in Table 7, a significant difference was found between the total scores of students' innovative thinking tendencies and the number of siblings variable (X^2 =17.599; p<0.05). Considering the sub-dimensions, significant differences have been identified between students' innovative self-efficacy (X^2 =12.921; p<0.05); innovative problem solving (X^2 =20.975; p<0.05), innovative perseverance (X^2 =12.456; p<0.05), innovative group leadership (X^2 =11.212; p<0.05) sub-dimensions and number of siblings variable. It can be said that as the number of siblings of the students increases, the scores of innovative thinking tendencies also increase.

The Kruskal Wallis test results of the innovative thinking tendency scores of the students according to their family income levels are given in Table 8.

Table 8. Innovative Thinking Tendency of the Students According to Their Family Income Levels

Factors	*Family Income Levels*	*N*	*Rank Average*	X^2	*p*
Innovative Self-efficacy	0-3000 TL	198	179,84	7,177	,127
	3001 TL-5000 TL	94	169,97		
	5,001 TL -7000 TL	33	158,12		
	7001 TL -9000 TL	16	232,63		
	9001 TL and more	15	201,30		
Openness to Innovation	0-3000 TL	198	184,46	7,904	,095
	3001 TL-5000 TL	94	169,26		
	5,001 TL -7000 TL	33	140,61		
	7001 TL -9000 TL	16	198,16		
	9001 TL and more	15	208,63		
Innovative Problem Solving	0-3000 TL	198	186,45	9,902	,042
	3001 TL-5000 TL	94	166,49		
	5,001 TL -7000 TL	33	148,27		
	7001 TL -9000 TL	16	155,06		
	9001 TL and more	15	229,03		
Innovative Perseverance	0-3000 TL	198	190,01	9,311	,054
	3001 TL-5000 TL	94	159,21		
	5,001 TL -7000 TL	33	159,98		
	7001 TL -9000 TL	16	150,78		
	9001 TL and more	15	206,70		
Innovative Group Leadership	0-3000 TL	198	170,84	5,078	,279
	3001 TL-5000 TL	94	176,09		
	5,001 TL -7000 TL	33	197,06		

	7001 TL -9000 TL	16	204,84		
	9001 TL and more	15	213,47		
Total	0-3000 TL	198	183,50	7,079	,132
	3001 TL-5000 TL	94	167,27		
	5,001 TL -7000 TL	33	151,58		
	7001 TL -9000 TL	16	197,19		
	9001 TL and more	15	222,17		

When the Kruskal Wallis test results in Table 8 were examined, it was determined that there was no significant difference between the innovative thinking tendencies of the students and the family income level variable (X^2 =7.079; p>0.05). When the sub-dimensions were examined, a significant difference was found only between the innovative problem-solving sub-dimension and the family income level (X^2 =9.902; p<0.05).

Discussion, Conclusion, and Recommendations

In this chapter, findings of the study have been discussed, conclusions are included and suggestions have been made according to these conclusions.

It has been determined that the innovative thinking tendencies of secondary school students are at a moderate level. This result obtained from the study differs according to the results obtained from different studies. In his study, Mısırlı (2015) states that secondary school students describe the area they consider themselves most competent as innovation. In a different study, Deveci and Kavak (2020) state that nearly half of the students have high innovative thinking tendencies. Muradoğlu (2020) similarly revealed that secondary school students' perceptions of innovative thinking are at a high level. Determining the innovative thinking tendencies of secondary school students is considered important for the studies to be carried out to develop them. Because it is known that the sooner innovative thinking is developed, the more successful and future-aspired students will be raised (Sokolov, Sergeicheva, & Sokolova, 2020).

When the total score averages of the innovative thinking tendency of female and male students were examined, it was determined that there is no significant difference. Aras (2020) concluded that innovative thinking levels did not differ statistically significantly in terms of gender variable. However, in the present study, it was found that female students had higher innovative thinking tendencies than average scores. The power of innovation to improve the quality of education is indisputable. In addition, it is an important need for all developing countries that girls find more place in education life with the understanding of education for everyone. For this reason, it is a pleasing result that girls' innovative thinking tendencies are higher. Moreover, in the innovative group leadership dimension, it was determined that the innovative thinking tendencies of male students were higher. Özdil Aydın (2009) in his research on leadership and social gender roles revealed differences in the behavior of men and women in terms of behavior in small groups. He mentioned that men tend to engage in tasks aimed at achieving mostly and show higher performance in terms of group efficiency (Özdil Aydın, 2009).

When the research findings are examined, it has been determined that the total and sub-factor score averages related to the innovative thinking tendencies of the students do not show a statistically significant difference in terms of the grade level variable. Looking at the general averages over the total score, it is seen that the innovative thinking tendency scores of 6th grade students are higher than other grade levels. Similarly, Muradoğlu (2020) concluded that the 'Innovative' scores of the 6th grade level secondary school students are higher than the 'Innovative' scores of the 8th grade level secondary school students. Aras (2020) also revealed in his research that there is a statistically significant difference in favor of the innovative thinking levels of sixth grade students. It is thought that this result obtained from the research is related to the loss of imagination in later ages. It is thought that innovation is related to individuals discovering new ways to realize their dreams and desires (Taş, 2017). It can be thought that the exam-oriented, oppressive and rote-learning based education system affects the thinking power and imagination of the students in the following grade levels.

Another result obtained from the research is that when the academic grade point average of the students increases, the innovative thinking tendency scores also increase. According to Koçak (2018); innovative thinking is also effective on academic success. Deveci and Kavak (2020) similarly

concluded that students' academic success is related to their innovative thinking tendencies. Knowledge shapes the basis of innovation and the innovation shapes the production of knowledge (Demirel & Seçkin, 2008). Students with high academic success adapt more easily to the lessons taught with new methods and techniques and offer new solutions in different problem situations. From this point of view, it can be thought that the way of thinking of students with high academic achievement also develops in the process.

When the innovative thinking tendencies of the students participating in the research were examined according to the award status, it was determined that the innovative thinking tendencies of the students who received the award were higher than the students who did not receive any awards. It is thought that this result obtained from the research is related to the motivation of the students. Extrinsic motivation, as well as intrinsic motivation, has an effect on individuals' innovative tendencies. Extrinsic factors, including the internal and environmental reward mechanisms of individuals, limit the negative effects of the uncertainty experienced by the individual. Thus, convenient conditions and a free environment for innovation can emerge (Öztürk Fidan & Fidan, 2017).

Another result obtained from the research is that as the number of siblings of the students increases, their innovative thinking disposition scores increase. Aras (2020) reached a similar conclusion in his research and explained this situation with the relationship between the increase in the number of siblings and the necessity of problem solving. In this study, a significant difference was found between the number of siblings of the students and the sub-dimensions of innovative self-efficacy and innovative problem solving. This situation has been associated with the fact that they frequently experience processes such as finding a voice in crowded families with a large number of siblings, defending their own ideas, contributing to the lives of others, or completing the unfinished business with patience.

Finally, in the study a significant difference was found between the innovative problem solving scores of the students and the family income level. It has been determined that students with high income levels also have a high innovative thinking tendency. It is thought that having a high social and economic status affects primarily the use and adoption of innovations (Wejnert, 2002). The results obtained from the research also support this. What should be noted here is that instead of seeing the income level as an important variable on innovation alone, it is more accurate to count it among the variables that affect innovation (Kılıçer, 2011). Another result obtained from the research, the high tendency of innovative thinking of students with low income level, is important in terms of reminding this. It is thought that the power of thought arising from impossibilities can reveal creative ideas.

Within the scope of the results obtained from the research;

Regardless of the level of education, students should be supported by the use of different methods and techniques in terms of innovative idea generation processes in their educational life. Students should be compared with new problem situations in different course contexts, and they should take an active role in processes such as approaching the problem, generating ideas, and applying the ideas produced. It is suggested that the barriers to innovative thinking of both students and teachers can be determined by a qualitative study using multiple data collection tools.

Acknowledgement

I would like to thank all secondary school students and school administration who participated in the research for their support.

References

Adıgüzel, A., Kaya, A., Balay, R. & Göçen, A. (2014). The relationship between teacher candidates' individual innovativeness and their learning attitudes. *The Journal of National Education, 43*(204), 135-154.

Aras, B. (2020). *Investigation of secondary school student's innovative thinking levels in terms of various variables* (Afyonkarahisar sampling) (Unpublished Master Thesis). Afyon Kocatepe University, Afyon.

Aydemir, A. (2021). Social innovation and lateral thinking tendencies of preservice social studies teachers. *International Journal of Progressive Education, 17*(3), 250-262. https://doi.org/10.29329/ijpe.2021.346.16

Çamlıbel Çakmak, Ö. (2012). Examining the relationship between pre-school teacher candidates' attitudes towards science education and understanding levels of science concepts. *Journal of Turkish Science Education, 9*(3), 40-51. Retrieved from https://www.proquest.com/docview/1658707290?pq-origsite=gscholar&fromopenview=true

Demirel, Y. & Seçkin, Z. (2008). The impact of knowledge and knowledge sharing on innovation. *The Journal of Institute of Social Sciences of Çukurova University, 11*(1), 189-202. Retrieved from https://web.s.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=0&sid=b14a347e-0f03-4223-bd82-af5a37389a92%40redis

Deveci, İ. & Kavak, S. (2020). Innovativeness perceptions and innovative thinking tendencies of middle school students: An exploratory sequential design. *Journal of Qualitative Research in Education, 8*(1), 346-378. https://doi.org/10.14689/issn.2148-2624.1.8c.1s.15m

Gök, S. B. (2021). *Reflections of the science-based enterprise training modules integrated with 5e learning cycle on the seven grade students' the innovative thinking tendencies* (Unpublished Master Thesis). Kahramanmaraş Sütçü İmam University, Kahramanmaraş.

Johnston, R. E. & Bate, J. D. (2003), *The power of strategy innovation: A new way of linking creativity and strategic planning to discover great business opportunities*, New York: AMACOM

Karasar, N. (2022). *Bilimsel araştırma yöntemi: Kavramlar, ilkeler, teknikler* (37. Baskı). Ankara: Nobel Yayın Dağıtım.

Kılıçer, K. (2011). *Individual innovativeness profiles of prospective teachers in computer education and instructional technology* (Unpublished Doctoral Thesis). Anadolu University, Eskişehir.

Koçak, B. (2018). Social studies pre-service teachers' perceptions about the concept of innovation. *Journal of Innovative Research in Social Studies, 1*(2), 80-87. Retrieved from https://dergipark.org.tr/en/pub/jirss/issue/41711/501051

Koştur, H. İ. (2019). Identifying preservice primary school teachers' views on science education. *Ihlara Journal of Educational Research, 4*(1), 144-154. Retrieved from http://ihead.aksaray.edu.tr/en/download/article-file/751661

Mısırlı, Z.A. (2015). Investigation of secondary school students' competencies regarding educational technology standards. *International Journal of Turkish Education Sciences, 5*, 311-337. Retrieved from https://dergipark.org.tr/en/pub/goputeb/issue/34517/385024

Ministry of National Education [MoNE] (2018). Science Course Curriculum (Primary and Secondary School 3, 4, 5, 6, 7 and 8). Ankara: Ministry of National Education Publishing.

Muradoğlu, B. (2020). *Secondary school students' perceptions and indicators of innovativeness in science courses* (Unpublished Master Thesis). Trabzon University, Trabzon.

Mykhailyshyn, H., Kondur, O. & Serman, L. (2018). Innovation of education and educational innovations in conditions of modern higher education institution. *Journal of Vasyl Stefanuk Precappathian National University, 5*(1), 9-16. https://doi.org/10.15330/jpnu.5.1.9-16

Oktuğ, Z. & Özden, M. S. (2013). The moderating role of intrinsic motivation on the relationship between individualism/collectivism and individual innovativeness. *Eskişehir Osmangazi University Journal*

of Social Sciences, 14(2), 1-22. Retrieved from https://dergipark.org.tr/en/pub/ogusbd/issue/11005/131670

Özdil Aydın, E. Ö. (2009). Investigating the relationship between transformational leadership and gender (Unpublished Master Thesis). *Ankara University, Ankara*.

Öztürk Fidan, İ. & Fidan, T. (2017, October). *The mediating role of intrinsic motivation in the effect of extrinsic motivation on innovativeness and the differential effect of uncertainty*. International Education Management Forum (EYFOR8), Ankara, Türkiye.

P21, Partnership for 21st Century Skills. (2015). P21 Framework Definitions. Retrieved from https://files.eric.ed.gov/fulltext/ED519462.pdf

Sokolov, K. O., Sergeicheva, I. A. & Sokolova, M. I. (2020, April). *Innovative thinking development in engineers*. In *Journal of Physics: Conference Series* (Vol. 1515, No. 2, p. 022012). IOP Publishing. https://doi.org/10.1088/1742-6596/1515/2/022012

Şanlı, S. (2020). *Evaluation of middle school social studies textbooks in the context of innovative thinking* (Unpublished Master Thesis). Akdeniz University, Antalya.

Taş, S. (2017). Innovation, education and global innovation index. *Bilge International Journal of Social Research, 1*(1), 99-123. Retrieved from https://dergipark.org.tr/en/download/article-file/340018

Wejnert, B. (2002). Integrating models of diffusion of innovations: A conceptual framework. *Annual Review of Sociology, 28*, 297-326. https://doi.org/ 10.1146/annurev.soc.28.110601.141051

Wisetsat, C. & Nuangchalerm, P. (2019). Enhancing innovative thinking of Thai preservice teachers through multi-educational innovations. *Journal for the Education of Gifted Young Scientists, 7*(3), 409-419. https://doi.org/10.17478/jegys.570748