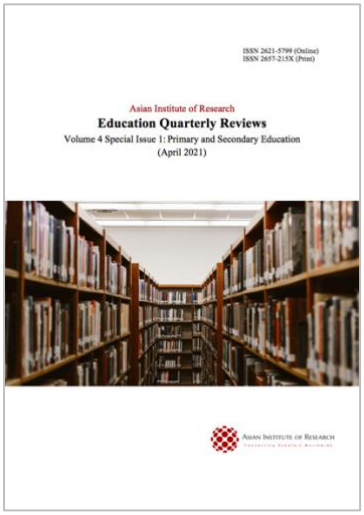

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The Relationship Between Individual Innovativeness and Techno-Pedagogical Levels of School Administrators and Teachers*

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Abstract
In research on the use of technology in education, it is emphasized that it is an indispensable requirement of our age, therefore, educators should be developed in terms of techno-pedagogy. In this study, total 1735 school administrators and teachers' individual innovation qualifications and techno-pedagogical education competences were investigated, who are working at primary, middle school and preschool levels in Turkey's province Samsun. Within the scope of the research, personal information inventory, Technopedagogical Education Competence (TPACK ‐ deep) Scale and Individual Innovativeness Scale were used. In the analysis of the data, the SPSS package program was used. According to the results of the research, it was seen that the techno-pedagogical education proficiency score of the participants was 4.01 which is in the advanced level. The average score that teachers got from the Individual Innovativeness scale was found to be 70.60 (category in the pioneer). According to the results of the correlation analysis, it was determined that both individual innovativeness and techno-pedagogical education competences levels have a significant correlation relationship with each other at the level of 0.01.

Keywords: Technopedagogy, Individual Innovation, Teacher, School Administrators

1. Introduction

1.1. Use of Technology in Education

The question of whether or not technology should be used in education, now has left its place to such questions; "How should we integrate technology into education?" and "In what environments, in what ways and in what

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proportion should we use technology in education?" Because it has become a necessity to use technology in a suitable environment and at sufficient rate in education (Akgündüz, 2016; Karaman, 2010). The hard conditions with Covid-19 epidemic, has showed how important the technology is in education. During the epidemic, some teachers adapted more easily to the use of technology in distance education processes, while others had difficulty accepting the existing situation (Alper, 2020 For this reason, technology integration in education is not just a matter of yesterday or today. Supporting learning for a specific plan and purpose, introducing new thinking processes, facilitating difficult activities and learning processes, and cooperating with stakeholders will also hold an important place in the future (Kurt, Şahin-İzmirli & Karakoyun, 2009).

The education process, which started with the chalkboard in the past, over time; continues with the use of many different devices and applications such as TV broadcasts, computers, overhead projectors, videos, podcasts, tablets, smart boards and wearable technologies in education (Kurtoğlu-Erden & Uslupehlivan, 2020).As technological devices develop, appropriate software and virtual reality applications are also produced., and it is really hard to estimate how far these developments will become. In this point, School teachers and principals, who are responsible to execute the education process, are expected to be open to innovations, to be pioneer to change in a planned way and should have the ability of technology-based teaching. (Şahin & Aslan, 2008).

While declaring the qualities which the Teachers should have, Ministry of National Education emphasizes the statement that " In the process of teaching and learning, teachers are expected to use appropriate tools, information and communication technologies effectively" (Milli Eğitim Bakanlığı [MEB], 2017). According to all these, techno-pedagogical competence has an extremely important place in the professional development of teachers.

1.2. Technological Pedagogical Content Knowledge (TPCK)

In the relevant literature, for teachers to use technology more effectively in education it is seen that various models have been developed (Kaya & Yılayaz, 2013; Wang & Woo, 2007). "Technological Pedagogical Content Knowledge (TPCK)" approach put forward by Mishra and Kohler (2009) is one of them. They developed the "pedagogical content knowledge" model introduced earlier by Shulman (1986) and added the technology item to it. TPCK was first introduced as "Good teaching is not simply adding technology to the existing teaching and content domain. Rather, the introduction of technology causes the representation of new concepts and requires developing a sensitivity to the dynamic, transactional relationship between all three components suggested by the TPCK framework" (Koehler, M.J. & Mishra, P. 2005). As stated by Roblyer (2006), what is expected from the teacher is not how often she/he uses the technology, but that she/he is able use it by choosing the technology suitable for the educational content and pedagogical approach. In order to achieve a successful teaching, Techno-pedagogical education model requires teachers to use technology, pedagogy and content knowledge simultaneously (Kabakçı-Yurdakul et al., 2012).

Techno-pedagogy, in order to prepare a training program to provide a technology-supported education; It is described as an instructional design created by a team including teachers, students and instructional technologists (Kazu & Erten, 2011).

1.3. Factors Affecting Teachers' Use of Technology in Education

As Earle (2002) stated, technology integration is a process, not a product, and there are some factors that affect this process. Ertmer (2001) categorized the factors affecting teachers' use of technology in two groups: a. Those related to the teachers themselves (attitude towards technology, beliefs, practices and resilience) and b. Out of the teacher's control (access to technology, technical support, implementation time, etc.) T. Teo examined the factors affecting teachers' acceptance of technology in two headings: direct influencers and indirect influencers. According to him, the attitudes of individuals towards the use of technology and technopedagogical competencies are among the factors that directly affect teachers. He stated that the conditions related to the use of technology are among the factors that affect indirectly. Mazman and Usluel (2011), on the other hand,

discussed the factors that determine technology integration in education and play a role in the process in two dimensions: internal and external factors.

Kabakçı-Yurdakul and their friends (2014), who conducted a study in this field, conducted a study to determine techno-pedagogical education competencies and performance indicators. In this context, they determined the teachers' techno-pedagogical education competencies within six main competences: such as "designing the teaching process", "conducting the teaching process", "being open to innovations", "complying with ethical issues", "problem solving" and "specialization in the field", within the framework of the 120 performance indicators that determine these competences.

1.4. Individual Innovativeness

According to Rogers (2003), innovation in the most general sense is defined as "an idea, practice, or object perceived as new by individuals or adoptive units". He explains the dynamics of innovation with five items: Relative advantage, Compatibility, Complexity, Trialability, and Observability. Rogers defining innovativeness as one's adoption of new ideas earlier than others, states that instead of defining an individual as "less innovative than the average member of a social system", members of the social system can be classified on the basis of innovation. He makes the classification by dividing them into categories such as innovators, early adopters, early majority, late majority, laggards. In order to create positive results at the end, Özdemir (2000), defines innovation; as a pre-planned, controlled change. In order for the innovation to be adopted, it is also expected to have a testable feature and the emerging results to be visible or observable (Çuhadar et al., 2013). Innovation can also be defined as the willingness to try everything new and the desire to change (Braak, 2001; Hurt, Joseph, & Cook, 1977).

In a study conducted by Drent & Meelissen (2008) on teachers in the Netherlands, they found that personal entrepreneurship plays an important role in the use of information and communication technologies. According to Ertmer and Ottenbreit-Leftwich (2010), in order for teachers to use technology effectively in education; variables such as knowledge, self-efficacy, pedagogical beliefs and school culture should be taken into account. In the pandemic process in which distance education methods are applied, adaptation of teachers and school administrators to new conditions, and to carrying out the education in a healthy way, individual innovativeness features also have a great impact (Canpolat & Yıldırım, 2021). Especially, among the factors that affect teachers' use of technology, individual innovativeness plays an important role (Mazman & Usluel 2011).

Both the technological innovations of the 21st century and the compelling effects of distance education have created the need to investigate the technopedagogical levels of teachers and education administrators.

In the light of all these developments, it can be said that it is necessary to determine the techno-pedagogical education competencies of teachers and their individual innovativeness levels in the conduct of education and training processes and to investigate whether there is any relationship between these two.

1.5. Scope and Importance of The Research

In this study, it is planned to research the relationship between the techno-pedagogical education competencies of educators and their individual innovativeness. Within the scope of this general purpose, answers will be sought for the following questions.

1. What is the level of individual innovativeness and TPCK competence of teachers?
2. Do participants' individual innovativeness and techno-pedagogical education competencies show diversity according to the variables such as; gender, age, years of seniority, branch, school type, etc.?
3. Is there a meaningful relationship between educators' individual innovativeness characteristics and TPCK competencies?

The research is important in terms of professional development of teachers and school administrators, teacher training policies and technology integration in education.

2. Method

2.1. Research Design

In the study, relational scanning model was preferred among quantitative research methods. Relational scanning model is called scanning approach that aims to determine the existence of co-change between two or more variables. In the relational survey model, whether the variables change together or not; If there is a change, it is tried to be determined how it happened. (Karasar, 2011; Büyüköztürk et al. 2014).

2.2. Working Group and Research Process

The universe of the research consists of 20.581 teachers working throughout the city of Samsun. In the sample of the study, there are 1805 pre-school, primary and secondary school teachers selected by simple random sampling model from the universe. As a result of the statistical analysis, statements of 70 participants, who had extreme values and were left incomplete, were removed and not included in the evaluation. Accordingly, the sample of the study was determined as 1735 participants.

In order to collect data from the sample group, research permissions were obtained from Ondokuz Mayıs University Social and Human Sciences Ethics Committee and Samsun Provincial Directorate of National Education. Due to the difficulties brought by the Covid 19 process, it was decided to collect research data via Google Form application. The questionnaire text was uploaded to the system and the link address was sent to voluntary teachers between 1-30 September 2020, and no personal data was stored within the scope of the research.

2.3. Data Collection Tools

Techno-pedagogical Education Proficiency Scale (TPACK - deep) developed by Kabakci Yurdakul, Odabasi, Kilicer, Coklar, Birinci, Kurt (2012) was used as a data collection tool in order to determine the techno-pedagogical education competencies of teachers in the study. Techno-pedagogical Education Competence (TPACK - deep) Scale consists of 33 items and four factors. These factors are; design, implementation, ethics and specialization.

In this research was used "Individual Innovation Scale" adapted into Turkish by Kılıçer & Odabaşı (2010) in order to measure participants' individual innovativeness (originally developed in by Hurt and et al. in 1977). The validity and reliability of this scale was accepted by many researchers on testing different samples (internal consistency coefficient is 0.82, test-retest reliability is 0.87). It was determined that the 20-item Turkish scale has a four-factor structure, that its factor structures are valid.

Individuals can be categorized in terms of innovativeness according to the scores obtained on the scale. According to this, if individuals score above 80 points, they are interpreted as "Innovative", if between 69 and 80 points as "Pioneer", between 57 and 68 points as "interrogator", between 46 and 56 points as "Skeptic", and below 46 points as "Traditional" (Kılıçer & Odabaşı, 2010).

2.4. Data Analysis

The collected data was transferred to a computer environment. Inappropriate and extreme expressions has been removed from the data set. SPSS 22.0 package program was used in the analysis of the data and the significance level was accepted as 0,05 in the interpretation of the results. Independent sample t-test from statistics and one-way ANOVA were used, Correlation analysis and Regression Analysis, Tukey HSD test from Post Hoc tests was used.

3. Results

3.1. Findings Regarding the Demographic Characteristics of the Individuals Participating in the Study

The frequency and percentage values for the independent variables such as gender, duty, region, age, seniority year, school type of the teachers participating in the study are given in below.

Table 1: Frequency Tables

Independent Variable	Categories	N	Percent
Gender	Female	1027	59,2
	Male	708	40,8
District of Duty	Central District	621	35,7
	Remote District	1114	64,3
Age	20-30	192	11,1
	31-40	805	46,4
	41-50	519	29,9
	51 and above	219	12,6
Year Of Seniority	1-9 Years	427	24,6
	10-19 Years	762	43,9
	20-29 Years	423	24,4
	30 Years and above	123	7,1
School Level	Primary School	634	36,5
	Middle School	885	51,0
	Preschool	216	12,4
School Type	State school	1693	97,6
	Private school	42	2,4
Mission Title	Teacher	1519	87,6
	Assistant Manager	114	6,6
	Manager	102	5,9

As seen in Table 1, 59.2% of the teachers participating in the study are women and 40.8% are men. Considering the regions they work in, 64.3% of the teachers work in districts far from the centre. 46.4% of the participants are between the ages of 31-40, and in terms of years of seniority, it is seen that 43.9% of the participants have been working for 10-19 years. 51% of the participants are middle school teachers, 97.6% are employees in public schools and 87.6% of the participants are working as teachers.

3.2. Findings Regarding the General Purpose of the Study

The techno-pedagogical education proficiency score average of the participants in the study was found to be between 4.01 and advanced level. The mean scores of the sub-dimensions of TPCK, which are design, application, ethics and specialization levels, are given in Table 2 below.

Table 2: Techno-pedagogical Education Competence Scores of Teachers

		N	Minimum	Maximum	Mean	5- Likert	Std. Deviation
Technological Pedagogical Content Knowledge (TPCK)	Design	1735	19,00	50,00	39,3931	3,94	6,44665
	Application	1735	22,00	60,00	48,6836	4,06	7,48853
	Ethical	1735	8,00	30,00	25,8323	4,31	3,57779
	Specialization	1735	5,00	25,00	18,4697	3,69	3,97630

According to Table 2, it is seen that the highest average score of teachers for TPCK sub-dimensions belongs to the "Application" dimension. The lowest average score was found in the "Specialization" dimension.

Table 3: Teachers' Individual Innovativeness Tendencies

	N	Minimum	Maximum	Mean	Std. Deviation
Individual Innovation	1735	42,00	94,00	70,6023	10,35967

As seen in Table 3, the average score that teachers got from the scale of individual innovativeness is 70.60. Accordingly, we can say that the participants are in the "Pioneer" category. The results of the correlation analysis conducted to understand whether there is any relationship between teachers' technopedagogical education proficiency and their level of individual innovativeness are below.

Table 4: Correlation Analysis

Correlations		Bireysel Yenilikçilik	Teknopedagoji
Individual Innovation	Pearson Correlation	1	,557**
	Sig. (2-tailed)		,000
	N	1735	1735
Techno-pedagogical Competence	Pearson Correlation	,557**	1
	Sig. (2-tailed)	,000	
	N	1735	1735

**Correlation is significant at the 0.01 level (2-tailed).

According to the results of the correlation analysis, it was determined that both individual innovativeness and techno-pedagogical competence levels have a significant correlation relationship with each other at the level of 0.01.

The simple linear regression analysis results we have done to see whether teachers' individual innovativeness characteristics cause any difference on their techno-pedagogical competence levels are below.

Table 5: Regression Analysis

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the
1	,557[a]	,310	,310	,51405

a. Predictors: (Constant), Individual Innovation

According to the results of the regression analysis, it was seen that teachers' individual innovativeness levels affect their techno-pedagogical competence levels at a level of 31.1%.

Table 6: Regression Anova[a] Analysis

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	214,189	1	214,189	810,567	**,000[b]**
	Residual	476,435	1733	,264		
	Total	690,623	1734			

a. Dependent Variable: Techno-pedagogical Competence

b. Predictors: (Constant), Individual Innovation

The Anova results show that the model created in the way that individual innovation characteristics at the level of .000 affect the techno-pedagogical levels is confirmed.

3.3. Findings Regarding the Sub-Goals of the Study

3.3.1. The t-test results made to determine whether there is a meaningful differentiation between TPCK and Individual Innovativeness levels according to the gender variable of the teachers is given below.

Table 7: Gender, TPCK and Innovation traits t-Test

Scales	Sub Dimensions	Gender	N	$\bar{x}$	Ss	sd	t	p
Technological Pedagogical Content Knowledge (TPCK)	Design	Female	1027	3,85	6,55059	1733	-6,915*	.000
		Male	708	4,06	6,08211			
	Application	Female	1027	3,99	7,67840	1733	-5,498*	.000
		Male	708	4,15	7,04925			
	Ethical	Female	1027	4,29	3,60115	1733	-1,353	.176
		Male	708	4,33	3,54152			
	Specialization	Female	1027	3,57	4,06523	1733	-7,829*	.000
		Male	708	3,87	3,67657			
Individual Innovation		Female	1027	69,90	10,53004	1733	-3.468*	001
		Male	708	71,63	10,02637			

When the data in Table 7 is examined, of the teachers in terms of TPCK; Design (t= -6,915), application (t= -1,353) and specialization (t= -7,829) dimensions and Individual Innovation levels were found to be significantly different in favor of male teachers.

3.3.2. The results of the t-test for the region variable where teachers work and TPCK and Individual Innovation scores are given in Table 8.

Table 8: The region where teachers work, TPCK and Innovation Scores T-test Table

Ölçekler	Alt Boyutlar	Bölge	N	$\bar{x}$	Ss	sd	t	p
Technological Pedagogical Content Knowledge	Design	Central District	621	39,1176	6,47756	1733	-1.327	.185
		Remote District	1114	39,5467	6,42715			
	Application	Central District	621	48,4412	7,50066	1733	-1,006	.315
		Remote District	1114	48,8187	7,48172			
	Ethical	Central District	621	25,8631	3,48484	1733	.271	.786
		Remote District	1114	25,8151	3,63000			
	Specialization	Central District	621	18,0419	4,17692	1733	-3.278	.001*
		Remote District	1114	18,7083	3,84121			
Individual Innovation		Central District	621	70,62	10,52451	1255	.048	.962
		Remote District	1114	70,60	10,27138			

According to Table 8, it has been observed that the TPCK Specialization dimension scores of the teachers working in the Central districts (İlkadım, Atakum, Canik ve Tekkeköy districts) are higher than those working in remote districts (Alaçam, Asarcık, Ayvacık, Bafra, Çarşamba, Havza, İlkadım, Kavak, Ladik, Ondokuz Mayıs, Salıpazarı, Terme, Vezirköprü, Yakakent). No significant difference was found between the groups as a result of the t-test conducted for the individual innovativeness levels depending on the region where teachers work.

3.3.3. The results of analysis of variance between teachers' age groups and TPCK and Individual Innovativeness

Table 9: Variance Analysis Table Age Group Variable and TPCK and Individual Innovation Scores

Scales	Sub Dimensions	Source	Sum of Squares	sd	Mean of squares	f	p
Technological Pedagogical Content Knowledge	Design	Intergroups	472,544	3	58,170	1,405	,130
		In groups	71591,373	1731	41,405		
		Total	72063,917	1734			
	Application	Intergroups	814,007	3	66,344	1,185	,272
		In groups	96425,275	1731	55,982		
		Total	97239,282	1734			
	Ethical	Intergroups	70,426	3	14,284	1,117	,333
		In groups	22125,766	1731	12,787		
		Total	22196,193	1734			
	Specialization	Intergroups	244,954	3	35,611	2,279	,003
		In groups	27171,207	1731	15,627		
		Total	27416,161	1734			
Individual Innovation		Intergroups	149,721	3	83,119	,773	,718
		In groups	185947,870	1731	107,548		
		Total	186097,591	1734			

According to the results of the analysis of variance between the age groups of teachers and TPCK competence and individual innovativeness scores, it was seen that teachers differed in the specialization dimension, which is the sub-dimension of TPCK, and there was no difference between the groups in terms of individual innovativeness levels. Tukey HSD test results in the dimension of specialization, are shown in the table below.

Table 10: Tukey HSD Test Showing Among Age Groups the Sub-Dimension of Specialization Differentiates

				Groups			
	$\bar{x}$	n	Gruplar	20-30	31-40	41-50	51 and over
Specialization	19,1042	192	20-30 Yrs			*	*
	18,6969	805	31-40 Yrs			*	
	18,0713	519	41-50 Yrs				
	17,7553	219	51 and over				

As seen in Table 10, it has been observed that the teachers between the ages of 20-30 have a higher average than the teachers 41-50 and over 51 in the "specialization" sub-dimension. In the same direction, it has been noticed that teachers between the ages of 31-40 have a higher average than those of 51 and over age group. According to these results, it can be said that teachers in the younger group have a significant difference in specialization compared to those in the older group.

3.3.4. Variance analysis table for TPCK and individual innovativeness scores according to the seniority variable of teachers is given below.

Table 11: Variance Analysis of Teachers' Seniority Year Variable with TPCK and Individual Innovation Scores

	Sub Dimensions	Source	Sum of Squares	sd	Mean of squares	f	p
Technological Pedagogical Content Knowledge	Design	intergroup	365,167	3	121,722	2,939	,032
		In-group	71698,750	1731	41,420		
		Total	72063,917	1734			
	Application	intergroup	523,868	3	174,623	3,125	,025
		In-group	96715,414	1731	55,873		
		Total	97239,282	1734			
	Ethical	intergroup	26,867	3	8,956	,699	,552
		In-group	22169,326	1731	12,807		
		Total	22196,193	1734			
	Specialization	intergroup	239,381	3	79,794	5,082	,002
		In-group	27176,781	1731	15,700		
		Total	27416,161	1734			
Individual Innovation		intergroup	286,267	3	95,422	,889	,446
		In-group	185811,324	1731	107,343		
		Total	186097,591	1734			

As can be seen in Table 11, according to the results of analysis of variance between teachers 'seniority years and TPCK proficiency and individual innovation levels, teachers' technopedagogic proficiency scores differed significantly in design, application and specialization dimensions, which are the sub-dimensions. No differentiation was found between individual levels of innovation and years of seniority. Below is the table showing the result of the Tukey HSD test, which we conducted to see in which working periods / seniority years the differentiation occurred.

Table 12: Tukey HSD test showing between which seniority years the Design, Application and Specialization subgroups differ

	$\bar{x}$	n	Groups	1-9	10-19	20-29	30 Yrs and over
Design	39,5972	427	1-9 Yrs				
	39,6942	762	10-19 Yrs			*	
	38,5887	423	20-29 Yrs		*		
	39,5854	123	30 and over				
Application	49,0023	427	1-9 Yrs				
	49,0774	762	10-19 Yrs			*	
	47,7991	423	20-29 Yrs		*		
	48,1789	123	30 and over				
Specialization	19,0094	427	1-9 Yrs			*	
	18,4383	762	10-19 Yrs				
	17,9527	423	20-29 Yrs	*			
	18,5691	123	30 and over				

According to the results of the Tukey HSD test, a significant difference was found between 10-19 years and 20-29 years in the design dimension, between 10-19 years and 20-29 years in the application dimension, and between 1-9 years and 20-29 years in the specialization dimension. It has been observed that those who have worked for 10-19 years in the design dimension differ from those who have worked for 20-29 years, those who have worked for 10-19 years in the implementation dimension compared to those who have worked for 20-29 years, and those who have worked for 1-9 years in the specialization dimension compared to those who have worked for 20-29 years. Based on these results, we can say that teachers who are in the lower group in terms of seniority years have higher mean scores in design, implementation and specialization sub-dimensions compared to teachers with seniority years ahead.

3.3.5. The results of variance analysis for the school level variable where teachers work and TPCK and Individual Innovation scores are given in the table below.

Table 13: Variance analysis of TPCK and Individual Innovativeness scores according to the school level variable where teachers work

	Sub-Dimensions	Source	Sum of squares	sd	mean of squares	f	p
Technological Pedagogical Content Knowledge	Design	İntergroup	159,011	2	79,506	1,915	,148
		Ingroup	71904,906	1732	41,516		
		Total	72063,917	1734			
	Application	İntergroup	223,038	2	111,519	1,991	,137
		Ingroup	97016,243	1732	56,014		
		Total	97239,282	1734			
	Ethical	İntergroup	81,919	2	40,959	3,208	,041
		Ingroup	22114,274	1732	12,768		
		Total	22196,193	1734			
	Specialization	İntergroup	54,448	2	27,224	1,723	,179
		Ingroup	27361,713	1732	15,798		
		Total	27416,161	1734			
Individual Innovation		İntergroup	75,810	2	37,905	,353	,703
		Ingroup	186021,781	1732	107,403		
		Total	186097,591	1734			

According to Table 13, it was observed that the teachers differed in the ethical dimension, which is the sub-dimension of techno-pedagogical competence scores, and no differentiation was found between individual levels of innovativeness and the school level variable. The result of the Tukey HSD test we conducted in order to understand among which school levels the ethical dimension differs is given in the table below.

Table 14: School level variable TPCK ethical dimension Tukey HSD test

	$\bar{x}$	n	Groups	Groups		
				Preschool	Primary School	Middle School
Ethical	25,3611	216	Preschool			*
	25,7413	634	Primary School			
	26,0124	885	Middle School	*		

According to Tukey HSD results, a significant difference was observed between preschool teachers and secondary school teachers in the ethics sub-dimension. Middle school teachers' mean scores of ethics sub-dimension were found to be higher than the average scores of preschool teachers.

3.3.6. The results of the t-Test analysis of the school type variable and TPCK and Individual Innovation scores of teachers are given in the table below.

Table 15: School type variable with TPCK and Individual Innovation scores t-Test

	Sub-Dimensions	School Type	N	$\bar{x}$	Ss	sd	t	p
Technological Pedagogical Content Knowledge	Design	State school	1693	39,3314	6,44504	1733	-1,845	,010
		Private school	42	41,8810	6,07756			
	Application	State school	1693	48,6108	7,49099	1733	-2,682	,007
		Private school	42	51,6190	6,84658			
	Ethical	State school	1693	25,8151	3,57701	1733	-2,806	,212
		Private school	42	26,5238	3,58342			
	Specialization	State school	1693	18,4318	3,99093	1733	-1,266	,002
		Private school	42	20,0000	2,98778			
Individual Innovation		State school	1693	70,5387	10,3836	1733	-3,329	,072
		Private school	42	73,1667	9,08474			

When the data in Table 15 were interpreted it was seen that there was a significant difference in the design, application and specialization dimensions of teachers, which are sub-dimensions of TPCK. In each of the design, application and specialization dimensions, it has been observed that the average scores of teachers working in private schools are higher than those working in public schools.

3.3.7. The variance analysis results of the job title variable and TPCK and Individual Innovation scores of the participants are given in the table below.

Table 16: Variance analysis for job title variable and TPCK and Individual Innovation scores

	Sub-Dimensions	Source	Sum of Squares	sd	Mean of Squares	f	p
Technological Pedagogical Content Knowledge	Design	Intergroups	878,085	2	439,043	13,86	,000
		In groups	71185,832	1732	41,100		
		Total	72063,917	1734			
	Application	Intergroups	1003,825	2	501,912	10,682	,000
		In groups	96235,457	1732	55,563		
		Total	97239,282	1734			
	Ethical	Intergroups	53,410	2	26,705	2,089	,124
		In groups	22142,783	1732	12,785		
		Total	22196,193	1734			
	Specialization	Intergroups	734,504	2	367,252	23,840	,000
		In groups	26681,657	1732	15,405		
		Total	27416,161	1734			
Individual Innovation		Intergroups	2932,018	2	1466,009	13,86	,000
		In groups	183165,573	1732	105,754		
		Total	186097,591	1734			

It was observed that there was a difference in the job positions of the participants in school, their design, application and specialization features, which are sub-dimensions of TPCK, and their individual innovation features ($p < 0.05$). Tukey HSD test was conducted to understand among which groups this differentiation was present.

Table 17: Tukey HSD test for TPCK sub-dimensions with job title variable

	$\bar{x}$	n	Groups	Teacher	Asst. Mgr.	Manager
Design	39,1251	1519	Teacher		*	*
	41,1930	114	Assistant Manager	*		
	41,3725	102	Manager	*		
Application	48,3970	1519	Teacher		*	*
	50,7807	114	Assistant Manager	*		
	50,6078	102	Manager	*		
Specialization	18,2284	1519	Teacher		*	*
	19,8509	114	Assistant Manager	*		
	20,5196	102	Manager	*		
Individual Innovation	70,1145	1519	Teacher		*	*
	73,6842	114	Assistant Manager	*		
	74,4216	102	Manager	*		

As a result of the Tukey HSD test, it was detected that there was a difference in favor of the school principal in the mean scores of the TPCK scale design, application and specialization dimensions and individual innovation levels (=74,4216). We can say that the principal has a positive level in both TPCK sub-dimensions and individual innovation scores according to the teachers and vice principals and also that the vice principal has a positive level in both TPCK sub-dimensions and individual innovation scores according to the teachers.

4. Discussion

According to the results of the research, it was determined that the techno-pedagogical education proficiency score of the participants was 4.01 which is in the advanced level, the highest mean score in the TPCK sub-dimensions belonged to the "Application" dimension, and the lowest mean score belonged to the Specialization dimension. The average score that teachers got from the Individual Innovativeness scale was found to be 70.60, so we can say that the participants were in the "pioneer" category.

In the study conducted by Çuhadar, Bülbül, and Ilgaz (2013), teachers' individual innovativeness characteristics were found to be in the "interrogator" category, and their TPCK levels were found to be highly sufficient with an average of 3.93. Solmaz (2019) found the teachers' individual innovation levels in the "Openness to Experience" category, while their techno-pedagogical education competencies were in the "Advanced Level" range with an average of 3.78. Özbek (2014) found that teachers' TPCK mean score is 3.86; Şimşek and others (2013) found it 3.76; Kaya and Yazıcı (2019) found ($\bar{x}$ = 3,743) in the "Advanced Level" range. The situation that individual innovativeness features give similar results in various studies can be associated with the general competency requirements of the teaching profession and educational situations.

Based on research results, it can be said that there is a significant correlation between teachers' individual innovativeness and techno-pedagogical education competence levels at the level of 0.01, and individual innovativeness levels predict their techno-pedagogical education competencies at the level of 31.10%. Konaklı and Solmaz (2015) examined the relationship between teachers' individual innovation levels and techno-pedagogical competencies. In the results of the research, it has been observed that there is a moderate, positive and significant relationship between individual innovation level and techno-pedagogical competencies. It is seen that this result is in parallel with similar studies in the field; (Çuhadar, Bülbül & Ilgaz, 2013; Hermans, Tondeur, Haelermans & Blank, 2012; Braak & Valcke, 2008; Örün and others, 2015; Özbek (2014).

It was observed that male teachers' TPCK and individual innovation scores were higher than female teachers. There are also other researches that have found similar results; (Argon and Others, 2015; Kaya and Yazıcı (2019); Yalçın-İncik, 2017). There are also studies in the literature that do not find any difference between TPCK levels and gender; (Çuhadar, Bülbül & Ilgaz, 2013; Solmaz, 2019; Şimşek and others, 2013). In the Specialization dimension, which is the TPCK sub-dimension; It has been observed that they are ahead of those who work in central districts, and their level of individual innovativeness does not differ. This result may be due to the differentiation of roles for men and women in the society.

It has been observed that there is a significant difference in favor of young teachers in TPCK efficacy scores (0.03<0.05). In their study, Şimşek and others (2013) found that the average TPCK score of the lecturers in the age group of 31-40 was higher than those of the lecturers over the age of 50.

The research, it was seen that there is no difference between the age variable and individual innovativeness levels. Similarly, in the study conducted by Vatansever-Bayraktar & Karabulut (2020), there was no difference between age and individual innovativeness. The reason for the high TPCK scores of young teachers may be that they were born in the age of technology compared to older teachers.

It can be said that there is a differentiation between the years of seniority of teachers and the sub-dimensions of TPCK, design, application, and specialization the average scores of (in favor of with low seniority years) the teachers. Yalçın-İncik (2017) found that teachers whose seniority years are between 11-15 years have higher

TPCK proficiency scores than teachers with 26 years and more. Solmaz (2019) noticed a significant difference between the seniority variable and the "openness to experience" dimension of individual innovativeness and the design, implementation and specialization dimensions of the TPCK sub-dimensions in favor of teachers with seniority of 1-5 years; and also Özbek (2014) stated that the professional seniority year does not cause any differentiation on individual innovativeness.

In the TPCK Ethical dimension, it was determined that the mean scores of the teachers working at the middle school level were higher than the teachers working in pre-school ($\bar{x}$ = 26,0124) and there was no difference in terms of individual innovativeness. When considered in terms of school type, it was observed that there is a significant difference in the design, application and specialization dimensions of TPCK sub-dimensions and individual innovativeness levels. It can be said that the teachers working in private schools have higher levels of techno-pedagogical competence and individual innovativeness than those working in public schools.

It was observed that there was a significant difference in the task positions (Teacher, Asst. Mgr., Manager) of the participants, TPCK design, application and specialization dimensions and individual innovation levels. Accordingly, it can be said that the techno-pedagogical competence and individual innovation levels of school principals are higher than the others. In the study conducted by Şimşek and others (2013) on faculty members who are university personnel, titles such as professor, associate professor and assistant do not cause any differentiation in the TPCK scores of faculty members. In the light of this research, we can say that in order to improve the techno-pedagogical education competencies of teachers, we need to develop their individual innovativeness characteristics and also we should take into account their different variables such as age, gender and job positions. It is thought that studying the findings of the research with a qualitative research, taking the mentioned variables into account, will be effective in terms of better enlightenment of the subject.

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