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Is Individual Innovativeness Decisive in Preservice Teachers' ICT Competencies?

Filiz MUMCU *[1]

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ABSTRACT

This study is associational research conducted to investigate whether the preservice teachers' individual innovativeness is decisive in their ICT competencies, one of their innovative teaching competencies. A convenience sampling method was used in sampling. 422 preservice teachers were students of the education faculties of six universities in Turkey and participated voluntarily in the study. Preservice Teachers' ICT Competencies Scale developed by Tondeur et al. (2017) and Innovativeness Scale developed by Hurt et al. (1977) were used to collect the data. Data were analyzed by descriptive statistics, ANOVA, and correlation analysis. The individual innovativeness levels of the majority of preservice teachers are low. More than half of the preservice teachers were at the early majority level. Preservice teachers with low innovativeness levels had low ICTC-ID and ICTC-PU competencies, and those with high levels were higher. A significant and positive correlation was found between preservice teachers' innovativeness levels and ICTC-PU and ICTC-ID competencies. There was a significant and positive relationship between sub-dimensions of innovativeness scale, risk-taking, openness to experience, and opinion-leading and ICTC-PU and ICTC-ID competencies. There was no relationship between the resistance to change, one of the innovativeness scale sub-dimensions, and ICT competencies. As the innovativeness levels of preservice teachers increased, their ICT competencies also increased. Therefore, the individual innovativeness variable appears to be an important factor in developing preservice teachers' ICT competencies.

Öğretmen Adaylarının BİT Yeterliklerinde Bireysel Yenilikçilik Belirleyici midir?

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ÖZET

Bu çalışma, öğretmen adaylarının bireysel yenilikçilik özelliklerinin yenilikçi öğretim yeterliklerinden BİT yeterliklerinde belirleyici olup olmadığını incelemek amacıyla yapılan ilişkisel bir araştırmadır. Örneklem seçiminde elverişli örneklem yöntemi kullanılmıştır. Araştırmaya Türkiye'deki altı devlet üniversitesinin eğitim fakültelerinde öğrenim gören 422 öğretmen adayı gönüllü olarak katılmıştır. Tondeur ve diğerleri tarafından geliştirilen Öğretmen Adaylarının BİT Yeterlikleri Ölçeği. (2017) ve Hurt ve diğerleri tarafından geliştirilen Yenilikçilik Ölçeği. (1977) verileri toplamak için kullanılmıştır. Veriler tanımlayıcı istatistikler, ANOVA ve korelasyon analizi ile analiz edilmiştir. Öğretmen adaylarının çoğunluğunun bireysel yenilikçilik düzeyleri düşüktür. Öğretmen adaylarının yarısından fazlası erken çoğunluk düzeyindedir. Yenilikçilik düzeyi düşük olan öğretmen adaylarının ICTC-ID ve ICTC-PU yeterlilikleri düşük, yenilikçilik düzeyi yüksek olan öğretmen adaylarının ICTC-ID ve ICTC-PU yeterlilikleri daha yüksektir. Öğretmen adaylarının yenilikçilik düzeyleri ile ICTC-PU ve ICTC-ID yeterlikleri arasında anlamlı ve pozitif bir ilişki bulunmuştur. Yenilikçilik ölçeği, risk alma, deneyime açıklık ve fikir önderliği alt boyutları ile ICTC-PU ve ICTC-ID yeterlikleri arasında anlamlı ve pozitif bir ilişki bulunmuştur. Yenilikçilik ölçeğinin alt boyutlarından biri olan değişime direnç ile BİT yeterlikleri arasında bir ilişki bulunamamıştır. Öğretmen adaylarının yenilikçilik düzeyleri arttıkça BİT yeterlikleri de artmıştır. Dolayısıyla bireysel yenilikçilik değişkeni öğretmen adaylarının BİT yeterliklerini geliştirmede önemli bir faktör olarak belirlenmiştir.

* *Corresponding Author, filizkuskaya@gmail.com*
[1]*Manisa Celal Bayar University*

1. Introduction

Technology has been constantly developing and changing, and we have been trying to catch up with this speed in integrating technology into our lives. We are exposed to change in many areas, individually, socially, and organizationally. As educators, we strive to equip ourselves and our students with the competencies to adapt to this change. Teachers are the most important actors in using many innovations related to technology and education in learning and teaching processes (Admiraal et al., 2017). First of all, teachers are expected to keep up with this change and to use technology effectively in classrooms (Angeli & Valanides, 2009). They should have digital skills and competencies (Kozma, 2010). So as teacher educators, we also need to take a closer look at teachers, teacher competencies, and teacher education processes.

The perceived competence of teachers in integrating information and communication technologies (ICT) into the learning and teaching process is vital for them to start integrating technology (Aslan & Zou, 2015). With digital technology, formal learning and informal learning have become an almost universal activity, and the digital competence required for this is of increasing importance to our current information society (He & Zhu, 2017). We must first ensure our teachers have the digital competencies that we want to teach our students so that we can make digital competencies a seamless part of the learning and teaching process.

There are frequently referenced international standards (such as the International Society for Technology Education [ISTE], Digital Competence Framework for Educators (DigCompEdu)) regarding the competencies that teachers/preservice teachers should have regarding effective use of ICT in learning and teaching processes. These standards are assembled within digital literacy, ICT literacy, and ICT competence (Tondeur et al., 2017). While the eyes are focused on teacher competencies globally, Turkey has made important initiatives at the national level in recent years. In addition to the "General Competencies of the Teaching Profession" report published by the Ministry of National Education of the Republic of Turkey in 2017, the changes made in teacher education programs by the Council of Higher Education in 2018. One of these changes is that teachers' effective use of ICT in the learning and teaching process is defined as one of the skills to be possessed in the teaching profession. The other is that preservice teachers should show their knowledge and skills acquired for teaching in front of their classmates and in a natural classroom setting. So, they can use ICT effectively in their learning and teaching processes. ICT competence includes the integrated and operational use of digital knowledge, skills, and attitudes (Hatlevik et al., 2015).

The digital competencies of teachers and preservice teachers are not yet at the desired level. Although junior teachers may appear to be digital natives, it does not imply they have sufficient digital competencies (König, Jäger-Biela, & Glutsch, 2020). Of course, there are many studies on the development of digital competences of teachers and preservice teachers (Çebi & Reisoğlu, 2019; Dias-Trindade, Moreira, & Ferreira, 2020; Engeness, 2021; Martín, González, & Peñalvo, 2020; Reisoğlu & Çebi, 2020). In addition to them, some studies emphasize the importance of technology acceptance to improve preservice teachers' digital competencies and focus on personal factors (e.g., Pynoo, 2018). Admiraal et al. (2017) mention five types of teachers based on their attitudes towards technology that constitutes school innovations and their beliefs about learner-centered teaching: 1) Student-centered teachers who adopt technology, 2) Teachers who criticize the use of technology at school, 3) Teachers who are uncomfortable with technology, 4) Teachers uneasy with learned -centered teaching and 5) Teachers critical of a clear-cut stance. Hong et al. (2020) analyzed the role of teacher characteristics in their acceptance of educational policies to understand how ICT education policies are implemented in educational settings. According to the study, personal traits (self-efficacy and innovativeness in information technology) are positively associated with ease of understanding and ease of inclusion. Individual innovativeness in technology acceptance is an essential variable for perceived ease of use, perceived usefulness, and, ultimately, behavioral intention to use (Lee, 2019). When users have a higher level of innovativeness, they are more likely to adopt the technology. The individual innovativeness level of teachers determines their beliefs about using technology in the classroom (Lopez-Perez, Ramirez-Correa, & Grandon, 2019).

Thurling, Evers, and Vermeulen (2015) divided the factors that increase teachers' innovative behaviors in educational organizations into three main categories: *organizational*, *demographic*, and *individual*. Individual factors include personality, traits, and competence. It is the underlying reason for considering individual innovativeness in this study. Because Thurling, Evers, and Vermeulen (2015, p. 460) defined individual factors that increase teachers' innovative behaviors as developing specific competencies (self, skills, computer use, etc.), recognizing and evaluating opportunities, problem-solving and content knowledge of teaching. The influence of personal factors on the digital competencies of preservice teachers is one of the less-studied topics. That's why, there is a need for such studies that consider individual differences and needs in teacher education.

1.1. Innovativeness

Innovativeness can be defined as the degree to which individuals or institutions adopt an innovation (Rogers 1995). It is possible to encounter many definitions of innovation. The common point of these definitions is that

they vary from accepting an innovation immediately to rejecting it altogether (Demir Başaran & Keleş, 2015). Individual innovativeness has always been an important research topic. However, due to the rapid increase in the amount of innovation produced in recent years, the response time to innovations has shortened (Kılıçer and Odabaşı, 2013). For this reason, innovativeness has also attracted attention in recent years.

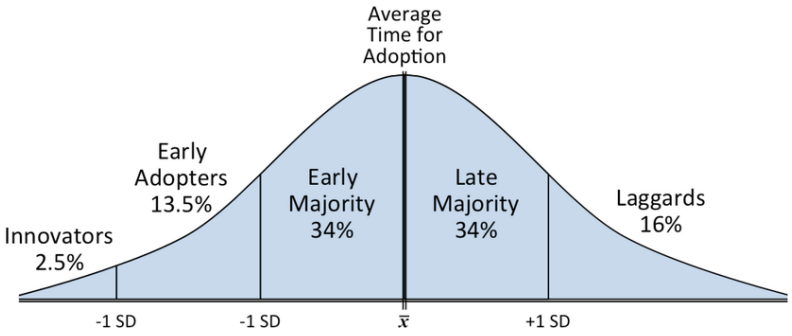
Rogers's (1995) diffusion of innovation theory has led to paramount studies in many areas. Education is one of them. According to Rogers (1995), perceived characteristics of innovation, communication channels, and time are essential factors in adopting innovation. Among them, time is one of the most critical elements in the diffusion process of the new. Time;

- The time elapsed from the moment the individual encounters the innovation to the moment he or she accepts or rejects the innovation (decision-making process),
- The process of adopting the innovation (adopter categories) of other members of the social system, and
- The number of individuals adopting innovation in a given period, namely the S curve (adoption rate).

When an innovation emerges in a system, everyone's adoption process is different. Rogers (2003) defines adopters in five categories (Figure 1).

Figure 1.

Adopter categories on the basis of innovativeness (Rogers, 2003)



- Innovators: Researchers have pointed out that audacity is a key innovation feature. They are experimentalists and have their own particular interest in technology. They love new ideas and are often the innovators. They make up 2.5% of the adopters.
- Early adopters: They are technically savvy. They are interested in technology to solve their professional or academic problems. They follow the opinion leader and are often the first to adopt an innovation. They make up 13.5%. They are technology-oriented, revolutionary change supporters, visionary users, project-

based, willing to take risks, willing to experiment, have individual competencies, and are individuals who tend to horizontal communication.

- Early majority: They are practitioners and form the first part of the majority. After the early adopters are the average members of a system, the new adopters. They make up 34%. Communicates frequently with peers, is willing to embrace the new, but rarely accepts leadership views.
- Late majority: They are the second part of the majority less related to technology. They are skeptical and often adopters of the new after the average members of a system. They make up 34%. They adopt because of network pressure and economic need, a useful novelty may persuade them, but only peer pressure will motivate them to adopt.
- Laggards: The last to adopt innovations are those who are relatively resistant to change. They make up 16%.

The successful use of instructional technology as an innovation in learning and teaching processes depends on the factors that significantly affect teachers' acceptance of technology, their intention to use it, and their actual use (Admiraal et al., 2017). Individual innovativeness is influential in teachers' technology acceptance (Mazman Akar, 2019). Uslu (2018), in his study on teachers, shows that individual innovativeness has the most significant indirect effect on technology integration. Gündüz (2021) revealed a positive relationship between teachers' innovativeness and digital nativeness levels. He concluded that individual innovativeness is a significant predictor of digital nativeness and explains 26% of digital nativeness. So as teachers' innovativeness levels increase, their digital nativeness levels also increase.

Zhu, Wang, Cai, and Engels (2013) define teachers' basic competencies required for innovative teaching: *learning competency*, *educational competency*, *social competency*, and *technological competency*. Learning competence shows that teachers are willing to learn about innovative teaching and increase teaching effectiveness, know how to learn, meet their needs, and are ready to take the initiative for their professional development. Social competence refers to an innovative teacher's ability to collaborate and establish positive relationships with students, colleagues, and others. Educational competence refers to teachers having the necessary pedagogical knowledge for innovative teaching, integrating them into their teaching, and guiding students' learning based on innovative teaching and learning principles. Technological competence is an indication that the teacher knows how to integrate innovative instructional technologies into the learning and teaching process. This study investigates whether the preservice teachers' individual innovativeness is decisive in their ICT competencies, one of their innovative teaching

competencies. It is crucial to know whether the innovativeness features that preservice teachers bring with them as individual differences are decisive on their digital competencies, which are very important for today's teaching profession. Thus, teacher training focusing on individual differences can be designed to develop preservice teachers' digital competencies.

2. Method

2.1. Research Design

This study is associational research conducted to investigate the relationship between individual innovativeness characteristics and the technological competencies, one of the innovative teaching competencies, of preservice teachers. Fraenkel, Wallen, and Hyun (2012, p. 16) defined associational research like that: "Research that investigates relationships is often referred to as associational research . Correlational and causal-comparative methodologies are the principal examples of associational research.". So, correlational and causal-comparative methodologies were used together in the research. No intervention was made in the group in which the research was conducted; the researcher sought to explore relationships among variables. In associational research, the relationships among two or more variables are studied without any attempt to influence them (Fraenkel, Wallen, & Hyun, 2012 p. 331). For these reasons, first, the existent individual innovativeness profiles of preservice teachers were described. The research questions are:

- R1: What are the individual innovativeness levels of preservice teachers?
- R2: Do preservice teachers' ICT competencies differ according to their innovativeness levels?
- R3: Is there a relationship between preservice teachers' ICT competencies and innovativeness levels?

2.2. Study Group

The research was carried out in the 2018-2019 academic year. A convenience sampling method was used in sampling. In this regard, 422 preservice teachers are students of the education faculties of Manisa Celal Bayar University, Marmara University, Afyon Kocatepe University, Uşak University, Hacettepe University, and Aksaray University in Turkey, participated voluntarily in the study. Demographic data of the study group are given in Table 1.

Table 1.

Demographic data of the study group

Variable	Group	N	%
Sex	Female	286	67,8
	Male	124	32,2
Grade	1	106	25,1
	2	162	38,4
	3	126	29,9
	4	28	6,6
Department	Pedagogical Counseling and Guidance (PCG)	157	37,2
	Computer Education and Instructional Technologies (CEIT)	142	33,6
	Elementary Mathematics Education	77	18,2
	Primary Education	20	4,7
	Science Education	17	4,0
	Turkish Education	9	2,1

When Table 1 is examined, 67.8% of the preservice teachers in the study group were female, and 32.2% were male, excluding missing data. PCG constituted most of the study group with 37.2%, followed by preservice teachers of CEIT with 33.6%. One hundred six preservice teachers (25.1%) were in the 1st grade, 162 preservice teachers (38.4%) were in the 2nd grade, 126 preservice teachers (29.9%) were in the 3rd grade, and 28 preservice teachers (%) 6.6), on the other hand, continued to the 4th grade.

2.3. Data Collection Tools

Preservice Teachers' ICT Competencies Scale

"Preservice Teachers' ICT Competencies Scale" developed by Tondeur et al. (2017) and adapted into Turkish by Mumcu, Uslu & Geriş (2018) was used. The scale was developed to measure preservice teachers' ICT competencies. The scale consists of 2 factors and 19 items: ICT Competence Pupil Use (ICTC-PU), ICT Competence Instructional Design (ICTC-ID). The items are in 5-point Likert type, and the answers are expressed as 1 = "I totally disagree", 5 = "I totally agree". The construct validity of the scale was examined by exploratory and confirmatory factor analysis in the original study:

- The two-factor scale explained 56.3% of the total variance.
- The fit indices showed acceptable/perfect fit.
- The Cronbach α internal consistency coefficient was calculated as 0.94 for the ICTC-PU factor and 0.89 for the ICTC-ID factor.

Innovativeness Scale

"Innovativeness Scale" was developed by Hurt et al. (1977), the Turkish version of the scale was adapted by Kılıçer and Odabaşı (2010). The scale determines the adopter categories of individuals. The items are in 5-point Likert type, and the answers are expressed as "Strongly Disagree = 1; Disagree = 2; Neutral = 3; Agree = 4; Strongly Agree = 5" and consists of 20 items (8 negative, 12 positive) in 5-point Likert type. The scale consists of four sub-factors: opinion-leading, openness to experience, risk-taking, and resistance to change. A minimum of 14 and a maximum of 94 points can be obtained from the scale. Those scoring above 80 on the scale are categorized as innovators, between 69-80 as early adopters, between 57-68 as early majority, between 46-56 as late majority, and below 46 as laggards. People who score above 68 are considered highly innovative, while those who score below 64 are seen as low in innovativeness. The original study found that:

- The four-factor scale explained 52.5% of the total variance.
- The Cronbach α internal consistency coefficient of the scale is 0.82.
- According to the test-retest reliability analysis results, the Pearson moments product correlation coefficient was calculated as 0.87, and a high level, positive and significant relationship was found between the two tests.

Table 2.

Innovativeness scale levels and score ranges

Innovativenesslevel	Score ranges
Innovators	Over 80 points
Early adopters	Between 69 - 80 points
The early majority	Between 57 - 68 points
The late majority	Between 46 - 56 points
Laggards	Under 46 points

2.4. Data Collection and Analysis

Data was collected via Google Forms. Then, it was analyzed with the SPSS program. First of all, outlier data were determined by Mahalanobis distance analysis, and data of 9 preservice teachers were excluded from the analysis. The analysis was made with the data of the remaining 413 preservice teachers. Afterward, it was tested whether the variables met the assumption of normality. In examining the normal distribution, the skewness and kurtosis coefficients were examined. Since the skewness and kurtosis values of the variables changed between +1 and -1 values, it was determined that the data were normally distributed (Büyüköztürk, 2002). Data were analyzed by descriptive statistics, ANOVA, and correlation analysis.

3. Result

3.1. Innovativeness Levels of Preservice Teachers

The innovativeness levels of preservice teachers were examined through descriptive statistics. More than half of the preservice teachers (51.3%) were at the early majority level. There were very few preservice teachers at the laggards and innovators levels. 30% of preservice teachers were at the level of early adopters and innovators. Since those who score above 68 on the scale (i.e., those who fall into the early adopters and innovators category) were generally considered to be quite innovative, it has seen that the individual innovativeness levels of the majority of preservice teachers were low. This situation is also shown in Graph 1.

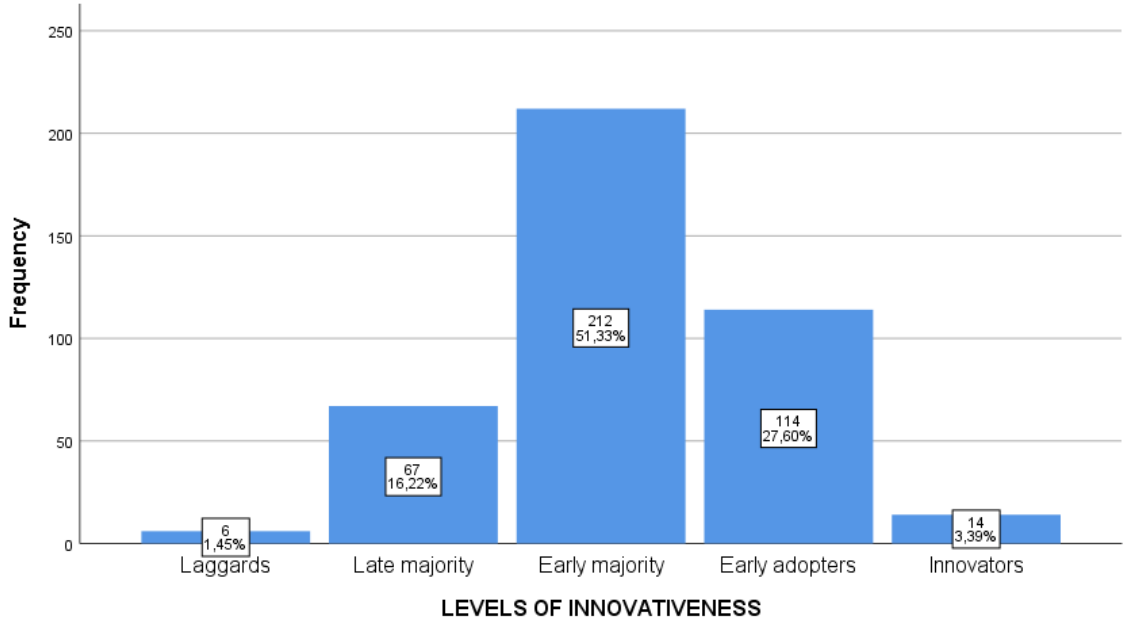
Table 3.

Innovativeness levels of preservice teachers

Levels	Frequency	Percent	Valid Percent	Cumulative Percent
Laggards	6	1,5	1,5	1,5
Late majority	67	16,2	16,2	17,7
Early majority	212	51,3	51,3	69,0
Early adopters	114	27,6	27,6	96,6
Innovators	14	3,4	3,4	100,0
Total	413	100,0	100,0	

Graph 1.

Innovativeness levels of preservice teachers



3.2. Preservice Teachers' ICT Competencies by Innovativeness Level

Descriptive statistics of preservice teachers' ICT competencies are given in Table 4. The average score of "the competence to support students for ICT use in the classroom (ICTC-PU)" was calculated as 42.47, and the average score of "the competence to use ICT for instructional design (ICTC-ID)" was calculated as 29.28.

Table 4.

ICT competencies of preservice teachers

	N	Minimum	Maximum	Mean	Std. Deviation
ICTC-PU	413	11	55	42,47	6,966
ICTC-ID	413	8	40	29,28	5,242
Valid N (listwise)	413				

One-way analysis of variance (ANOVA) was conducted to examine whether preservice teachers' ICT competencies differed significantly according to their innovativeness levels. ANOVA results are given in Table 5. Bonferroni, one of the post-hoc tests, was used to examine the differences between subgroups.

Table 5.

Findings of ANOVA for ICT competencies by innovativeness

	Source of variance	Sum of squares	DF	Mean squares	F	p	Bonferroni
ICTC-PU	Between groups	1933.261	4	483.315	10.920	.000*	1-2; 1-3; 1-4; 1-5; 2-3; 2-4; 2-5; 3-5
	In groups	18058.647	408	44.261			
	Total	19991.908	412				
ICTC-ID	Between groups	1551.650	4	387.913	16.201	.000*	1-2; 1-3; 1-4; 1-5; 2-4; 2-5; 3-4; 3-5
	In groups	9768.923	408	23.943			
	Total	11320.573	412				

** α=0.05; 1: Laggards 2: Late majority 3: Early majority 4: Early adopters 5: Innovators*

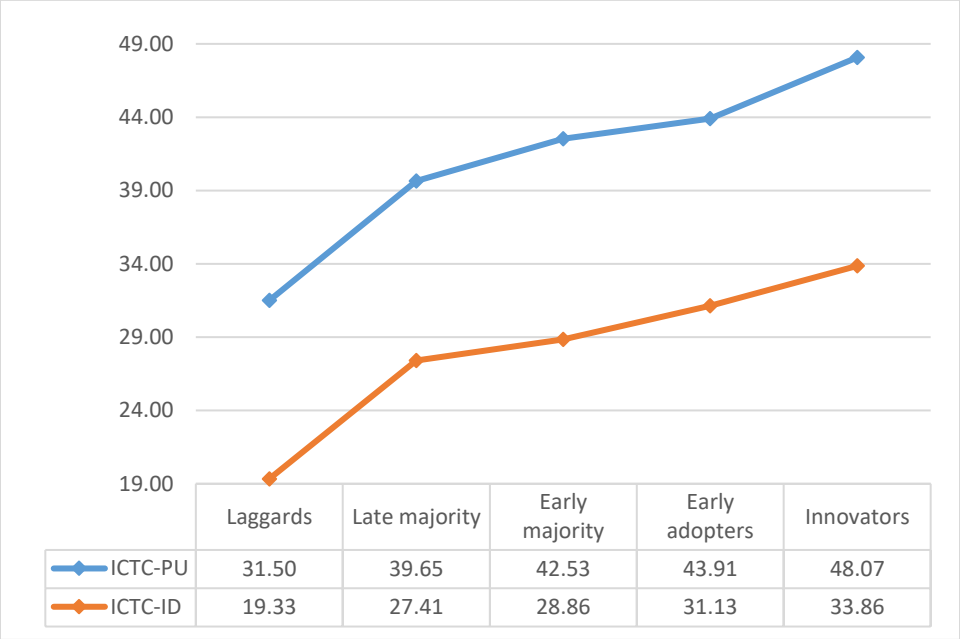
According to Table 5, a significant difference was found between the innovativeness and ICTC-PU (the competence to support students for ICT use in the classroom (F=10.920, p<=0.05)) and ICTC-ID (the competence to use ICT for instructional design (F=16.201, p<=0.05)).

There was a significant difference between laggards and early majority, early adopters and innovators in terms of ICTC-PU competencies of preservice teachers. In addition, there was a significant difference between the late majority and early adopters and innovators. This difference is in favor of those with higher levels of

innovativeness. There was a significant difference between laggards and all other levels regarding preservice teachers' ICTC-ID competencies. In addition, there was a significant difference between the late majority and early majority and early adopters and innovators preservice teachers in terms of ICTC-ID scores. ICTC-ID competencies of early adopters and innovators preservice teachers, who were stated to be quite innovative, were significantly different from the others. When Graph 2 is examined, the ICTC-PU scores of the preservice teachers were generally better than the ICTC-ID scores, and both scores increased as the innovativeness level increased.

Graph 2.

ICT competencies of preservice teachers by innovativeness level



	Laggards	Late majority	Early majority	Early adopters	Innovators
ICTC-PU	31.50	39.65	42.53	43.91	48.07
ICTC-ID	19.33	27.41	28.86	31.13	33.86

People who score above 68 on the scale (those who fall into the early adopters and innovators category) were generally considered quite innovative. As a matter of fact, in terms of ICTC-PU and ICTC-ID dimensions, early adopters and innovative preservice teachers' ICT proficiency were significantly higher than others.

3.3. Correlation Between Preservice Teachers' ICT Competencies and Innovativeness Levels

Correlation analysis was conducted to examine whether a significant relationship exists between preservice teachers' ICT competencies and innovativeness scores. Analysis results showed a significant and positive relationship between innovativeness scores and ICTC-PU and ICTC-ID scores (r=0.317; r=0.345). While this correlation was weak, the relationship between preservice teachers' ICTC-PU and ICTC-ID scores were significant, positive, and high (r=0.799).

Table 6.

Correlation between preservice teachers' ICT competencies and innovativeness

		Innovativeness	ICTC-PU	ICTC-ID
Innovativeness	Pearson Correlation	1		
ICTC-PU	Pearson Correlation	,317**	1	
ICTC-ID	Pearson Correlation	,345**	,799**	1

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

Correlation analysis was conducted to examine whether there was a relationship between the sub-dimensions of innovativeness (resistance to change, risk-taking, openness to experience, and opinion-leading) and ICTC-PU, ICTC-ID. There was no significant relationship between resistance to change and ICTC_PU and ICTC_ID competencies. There was a significant and positive relationship between opinion-leading, openness to experience, and risk-taking and ICTC_PU and ICTC_ID competencies.

Table 7.

Correlation between preservice teachers' ICT competencies and innovativeness levels

Variable	**ICTC_PU**	**ICTC_ID**	**Resistance to change**	**Opinion-leading**	**Openness to experience**	**Risk-taking**
ICTC_PU	1					
ICTC_ID	,799**	1				
Resistance to change	,007	-0.05	1			
Opinion-leading	,345**	,390**	,004	1		
Openness to experience	,437**	,434**	-,084	,626**	1	
Risk-taking	,264**	,292**	,073	,340**	,493**	1

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

The openness to experience had a higher correlation with ICT competencies. The risk-taking had a lower correlation with ICT competencies than others. In addition, ICTC-ID competencies and opinion-leading and risk-taking features had a higher correlation than ICTC_PU.

4. Discussion and Conclusion

This study investigates whether the preservice teachers' innovativeness is decisive in their ICT competencies, one of their innovative teaching competencies. The individual innovativeness levels of the majority of preservice teachers were low. More than half of the preservice teachers were at the early majority level. This finding is in line with other studies in the literature. In studies conducted with preservice teachers, the preponderance is at

the early majority level (Çuhadar, Bülbül, & Ilgaz, 2013; Kılıçer, 2011; Korucu & Olpak, 2015; Özgür, 2013). The same is true for the studies conducted with teachers (Demir Başaran & Keleş, 2015; Kozikoğlu & Küçük, 2020; Mazman Akar, 2019; Yılmaz Öztürk & Summak, 2014). This finding shows that there is a need for studies to improve the innovativeness levels of preservice teachers. Individual innovativeness is a feature that can be developed (Uslu, 2018).

A significant difference was found between the competence to support students for ICT use in the classroom (ICTC-PU) and the laggards and late majority groups and other groups. There was also a significant difference between the early majority and innovators. There was no significant difference between the early adopters and innovators groups, whose high individual innovativeness levels were. Preservice teachers with low individual innovativeness levels had low ICTC-PU competencies and those with high levels were higher. There was a significant difference between ICTC-PU competencies according to individual innovativeness levels. There were significant differences between laggards and other groups for the competence to use ICT for instructional design (ICTC-ID), between late majority and early majority groups, and early adopters and innovators groups. There was no significant difference between the early adopters and innovators groups, whose high individual innovativeness levels were. Preservice teachers with low innovativeness levels had low ICTC-ID competencies, and those with high levels were higher. There was a significant difference between ICTC-ID competencies according to individual innovativeness levels. These results show parallelism with the studies in the literature. Gökçearslan, Karademir, and Korucu (2017) found that preservice teachers in the early majority category have higher web pedagogical, web content knowledge, and general web knowledge scores than the late majority. They also found that individual innovativeness effectively predicted the general web and communicative web categories to which they belonged. In the research conducted to determine the Web 2.0 awareness of the instructors, their frequency of use, and their integration into the courses, it was determined that the awareness of the instructors who were at the level of innovators, early adopters, and early majority was higher (Mutlu Bayraktar, 2012).

A significant and positive correlation was found between preservice teachers' innovativeness levels and ICTC-PU and ICTC-ID competencies. This result is in parallel with the studies in the literature. Orhan Göksun and Kurt (2017) found that preservice teachers' innovativeness levels were related to 21st-century teaching skills but not 21st-century learner skills sub-dimensions. The scale used in this study to measure ICT competencies has two sub-dimensions: *the competence to support students for ICT use in the classroom* and *the competence to use ICT for*

instructional design. The scale is related to the teaching side. In this sense, a finding similar to Orhan Göksun and Kurt (2017) was obtained. There are some studies show a significant and positive relationship between preservice teachers' innovativeness and techno-pedagogical competencies (Çuhadar, Bülbül, & Ilgaz, 2013), critical thinking dispositions (Özgür, 2013), 21st-century learner skills (Orhan Göksun & Kurt, 2017; Karatepe & Akay, 2020), and technology attitude levels (Örün et al. 2015). There are similar findings in studies conducted with teachers. For example; there is a positive and significant relationship between teachers' creative thinking tendencies and individual innovativeness (Kozikoğlu & Küçük, 2020).

There was no relationship between the resistance to change, one of the innovativeness scale sub-dimensions, and ICT competencies. There was a significant and positive relationship between other sub-dimensions of innovativeness scale, risk-taking, openness to experience, and opinion-leading and ICTC-PU and ICTC-ID competencies. Examining entrepreneurship in teaching, Joensuu-Salo et al. (2020) showed that a teacher's innovativeness and risk-taking ability are positively related to the use of entrepreneurial teaching methods and that the teacher fosters the development of students' entrepreneurial competencies. The study also shows that teachers with lower innovativeness and lower risk-taking skills do not use entrepreneurial teaching methods as much as more innovative and risk-taking teachers.

Adoption of technological innovation is an essential predictor of innovative teaching behaviors (Chou et al., 2019). Educators have paramount responsibilities in raising individuals who adapt to technological developments, so teachers need to adopt innovations (Mazman Akar, 2019; Mutlu Bayraktar, 2012). It is predicted that teachers with innovative features will be more willing to adopt educational technologies and reflect them in their teaching (Atlı & Mazman, 2019). The acceptance of innovative technology affects teachers' willingness to use this technology in teaching at a later stage (Chou et al., 2019).

We can define a teacher's innovativeness as adopting new ideas, methods, and practices in teaching and learning processes. Zhu, Wang, Cai, and Engels (2013) stated that by developing teachers' fundamental competencies required for innovative teaching, insight can be provided for curriculum development in teacher education, and innovative competencies can be developed. Teachers' innovative teaching competence is a vital issue in educational technology. There is a need for studies to improve the innovativeness levels of preservice teachers.

4.1. Implications of Research

According to their innovativeness levels, preservice teachers' ICT competencies were significantly different. As the innovativeness levels of preservice teachers increased, their ICT competencies also increased. Therefore, the individual innovativeness variable appears to be an important factor in developing preservice teachers' ICT competencies. We know that ICT competencies do not only consist of technological knowledge and skills. It can be suggested that individual innovativeness levels should also be considered in the studies aimed at improving the ICT competencies of preservice teachers and that training should be organized according to different innovativeness levels of preservice teachers. Improving the innovativeness levels of preservice teachers should also be one of the teacher education programs aims.

4.2. Limitations and Suggestion

This study was limited to preservice teachers' self-report answers. Since the convenience sampling method was used to select the study group, the distribution in terms of branches and gender was determined according to voluntary participation. Therefore, variables such as gender and branch were not included in the analysis.

Ethical Declaration

In this study, all scientific ethical rules were followed.

Conflict Interest and Author Contributions

All stages of the study were organized and conducted by the Author(s). There is no conflict of interest.

5. References

Admiraal, W., Louws, M., Lockhorst, D., Paas, T., Buynsters, M., Cviko, A., ... & Kester, L. (2017). Teachers in school-based technology innovations: A typology of their beliefs on teaching and technology. *Computers & Education*, *114*, 57-68.

Angeli, C. & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education, 52*(1), 154-168.

Aslan A., & Zhu C. (2015). Starting teachers' integration of ICT into their teaching practices in the lower secondary schools in Turkey. *Kuram ve Uygulamada Eğitim Bilimleri, 18*(1), 23 – 45.

Atlı, Y. & Mazman Akar, S. G. (2019). Sınıf öğretmenlerinin bireysel yenilikçilik özellikleri ile derste teknoloji kullanımına yönelik eğilimleri arasındaki ilişkinin incelenmesi. *Uşak Üniversitesi Eğitim Araştırmaları Dergisi*, *5*(2), 1-31.

Büyüköztürk, Ş. (2002). *Sosyal bilimler için veri analizi el kitabı*. Ankara: Pegem Akademi Yayıncılık.

Chou, C. M., Shen, C. H., Hsiao, H. C., & Shen, T. C. (2019). Factors influencing teachers' innovative teaching behaviour with information and communication technology (ICT): The mediator role of organisational innovation climate. *Educational Psychology*, *39*(1), 65-85.

Çebi, A., & Reisoğlu, I. (2019). A training activity for improving the digital competences of pre-service teachers: The views of pre-service teacher in CEIT and other disciplines. *Educational Technology Theory and Practice, 9*(2), 539-565.

Çuhadar, C., Bülbül, T., & Ilgaz, G. (2013). Exploring of the relationship between individual innovativeness and techno-pedagogical education competencies of preservice teachers. *Elementary Education Online*, *12*(3), 797-807.

Demir Başaran, S., & Keleş, S. (2015). Yenilikçi kimdir? Öğretmenlerin yenilikçilik düzeylerinin incelenmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *30*(4), 106-118.

Dias-Trindade, S., Moreira, J. A., & Ferreira, A. G. (2020). Assessment of University Teachers on their digital competencies. *Qwerty-Open and Interdisciplinary Journal of Technology, Culture and Education*, *15*(1), 50-69. https://doi.org/10.30557/QW000025

Engeness, I. (2021). Developing teachers' digital identity: towards the pedagogic design principles of digital environments to enhance students' learning in the 21st century. *European Journal of Teacher Education*, *44*(1), 96-114. https://doi.org/10.1080/02619768.2020.1849129

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education*. 8th ed. McGraw-Hill ISBN: 978-0-07-809785-0

Gökçearslan, Ş., Karademir, T., & Korucu, A. T. (2017). Preservice teachers' level of web pedagogical content knowledge: Assessment by individual innovativeness . *Journal of Educational Computing Research*, *55*(1), 70-94.

Göksün, D. O., & Kurt, A. A. (2017). Öğretmen adaylarının 21. yy. öğrenen becerileri kullanımları ve 21. yy. öğreten becerileri kullanımları arasındaki ilişki. *Eğitim ve Bilim*, *42*(190), 107-130

Gündüz, Ş. (2020). Öğretmenlerin bireysel yenilikçilik ile dijital yerlilik düzeyleri arasındaki ilişkinin incelenmesi. *Eğitim ve Bilim*, *46*(205), 261-277

Hatlevik, O. E., Guðmundsdóttir, G. B., & Loi, M. (2015). Digital diversity among upper secondary students: a multilevel analysis of the relationship between cultural capital, self-efficacy, strategic use of information and digital competence. *Computers & Education, 81*, 345 – 353.

He, T., & Zhu, C. (2017). Digital informal learning among Chinese university students: the effects of digital competence and personal factors. *International Journal of Educational Technology in Higher Education*, *14*(1), 1-19.

Hong, J. C., Hwang, M. Y., Tsai, C. M., Liu, M. C., & Lee, Y. F. (2020). Exploring teachers' attitudes toward implementing new ICT educational policies. *Interactive Learning Environments*, 1-15.

Hurt, H. T., Joseph, K., & Cook, C. D. (1977). Scales for the measurement of innovativeness . *Human Communication Research*, *4*(1), 58-65.

Joensuu-Salo, S., Peltonen, K., Hämäläinen, M., Oikkonen, E., & Raappana, A. (2021). Entrepreneurial teachers do make a difference–Or do they?. *Industry and Higher Education*, *35*(4), 536-546.

Karatepe, R., & Akay, C. (2020). The study of the relationship between 21st-century learner skills, individual innovativeness and epistemological beliefs of teacher candidates by structural equation modelling. *South African Journal of Education, 40*(2), S1-S16.

Kılıçer, K., & Odabaşı, H. F. (2010). Bireysel yenilikçilik ölçeği (BYÖ): Türkçeye uyarlama, geçerlik ve güvenirlik çalışması. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *38*(38), 150-164.

Kılıçer, K. (2011). Bilgisayar ve öğretim teknolojileri eğitimi öğretmen adaylarının bireysel yenilikçilik profilleri. Doctoral dissertation, Anadolu University, Turkey.

Korucu, A., & Olpak, Y. (2015). Öğretmen adaylarının bireysel yenilikçilik özelliklerinin farklı değişkenler açısından incelenmesi. *Eğitim Teknolojisi Kuram ve Uygulama*, *5*(1), 109-127.

Kozikoğlu, İ., & Küçük, B. A. (2020). The Investigation of the Relationship between Teachers' Creative Thinking Tendencies and Individual Innovativeness Characteristics. *Journal of Education and Future*, (17), 25-37.

Kozma, R. B. (2010). ICT policies and educational transformation. http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/ED/ICT/pdf/ICTpoliedtran

König, J., Jäger-Biela, D. J., & Glutsch, N. (2020). Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany. *European Journal of Teacher Education*, *43*(4), 608-622. https://doi.org/10.1080/02619768.2020.1809650

Lee, M. S. (2019). Effects of personal innovativeness on mobile device adoption by older adults in South Korea: the moderation effect of mobile device use experience. *International Journal of Mobile Communications, 17*(6), 682-702.

Lopez-Perez, V. A., Ramirez-Correa, P. E., & Grandon, E. E. (2019). Innovativeness and factors that affect the information technology adoption in the classroom by primary teachers in Chile. Informatics in Education, 18(1), 165-181.

Martín, S. C., González, M. C., & Peñalvo, F. J. G. (2020). Digital competence of early childhood education teachers: attitude, knowledge and use of ICT. *European Journal of Teacher Education*, *43*(2), 210-223. https://doi.org/10.1080/02619768.2019.1681393

Mazman Akar, S. G. (2019). Does it matter being innovative: Teachers' technology acceptance. *Education and Information Technologies*, *24*(6), 3415-3432.

Mumcu, F., Uslu, N. A., & Geriş, A. (2018). A study of adaptation of preservice teachers' ICT competence scale into Turkish. *VIII. International Conference on Research in Education (ICRE 2018)*, May 9 – 11, Manisa, Turkey.

Mutlu Bayraktar, D. (2012). Adoption of web 2.0 tools and the individual innovativeness levels of instructors. *Journal of Hasan Ali Yücel Faculty of Education/Hasan Ali Yücel Egitim Fakültesi Dergisi (HAYEF)*, *9*(2).

Orhan Göksün, D., & Kurt, A. A. (2017). Öğretmen adaylarının 21. yy. öğrenen becerileri kullanımları ve 21. yy. öğreten becerileri kullanımları arasındaki ilişki. *Eğitim ve Bilim*, *42*(190).

Örün, Ö., Orhan, D., Dönmez, P., & Kurt, A. A. (2015). Öğretmen adaylarının bireysel yenilikçilik profilleri ve teknoloji tutum düzeyleri arasındaki ilişkinin incelenmesi. *Trakya Üniversitesi Eğitim Fakültesi Dergisi*, *5*(1), 65-76.

Özgür, H. (2013). Bilişim teknolojileri öğretmen adaylarının eleştirel düşünme eğilimleri ile bireysel yenilikçilik özellikleri arasındaki ilişkinin çeşitli değişkenler açısından incelenmesi. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, *9*(2), 409-420.

Pynoo, B. (2018). Strengthening teacher trainers ICT competencies through ICT Design Teams: Lessons learned. *Afrika Focus, 31*(1), 35-49.

Reisoğlu, İ., & Çebi, A. (2020). How can the digital competencies of preservice teachers be developed? Examining a case study through the lens of DigComp and DigCompEdu. *Computers & Education, 156*, 103940. https://doi.org/10.1016/j.compedu.2020.103940

Rogers, M. E. (1995). *Diffusion of innovations*. The Free Press (Fourth ed.), New York.

Rogers, M. E. (2003). *Diffusion of innovations*. The Free Press (Fifth ed.), New York.

Thurlings, M., Evers, A. T., & Vermeulen, M. (2015). Toward a model of explaining teachers' ınnovative behavior: A literature review. *Review of Educational Research*, *85*(3), 430–471. https://doi.org/10.3102/0034654314557949

Tondeur, J., Aesaert, K., Pynoo, B., van Braak, J., Fraeyman, N., Erstad, O. (2015). Developing a validated instrument to measure preservice teachers' ICT competencies: Meeting the demands of the 21st century. *British Journal of Educational Technology, 48*(2), 462–472.

Uslu, O. (2018). Factors associated with technology integration to improve instructional abilities: A path model. *Australian Journal of Teacher Education (Online)*, *43*(4), 31-50.

Yılmaz Öztürk, Z. & Summak, M. (2014). İlköğretim okulu öğretmenlerinin bireysel yenilikçiliklerinin incelenmesi. *International Journal of Sport Culture and Science*, *2*(Special Issue 1), 844-853.

Zhu, C., Wang, D., Cai, Y., & Engels, N. (2013). What core competencies are related to teachers' innovative teaching?. *Asia-Pacific Journal of Teacher Education*, *41*(1), 9-27.