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Exploring Pre-service Teachers' Perception Regarding Factors in Technology Integration with Q Methodology

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ABSTRACT

The aim of this study is to understand the perspectives of pre-service teachers on the factors affecting technology integration with the Q methodology. Forty-one pre-service teachers studying at the faculty of education of a state university participated in the research. Twelve statements reflecting the factors of technology integration were selected. In determining the Q statements, attention was paid to include elements at four levels in the integration process: teacher, institutional and system, teacher design thinking and student. The data were analyzed with the PQMethod 2.35 program. Principal component analysis was used in the factor analysis, and after the rotation process, a three-factor solution was reached: (a) individual-oriented perspective, (b) individual and school-oriented perspective, (c) planning, individual, school and system-oriented perspective. Among these identified perspectives, it was seen that there was a consensus on supporting teachers' professional development, access to technology, positive attitudes of students, and guidebooks supporting technology integration. However, it was seen that there were different areas in the opinions of the pre-service teachers in the three factors determined. It has been observed that pre-service teachers in the individual-oriented perspective prioritize teachers' value beliefs about the role of technology in education. It has been concluded that the pre-service teachers in the individual and school-oriented perspective attach more importance to the technological and pedagogical competencies of the teachers. It has been seen that the planning of the lesson plans for the integration of technology is a priority factor for the pre-service teachers with a planning, individual, institution and system-oriented perspective. Recommendations for teacher educators are presented for each identified perspective.

Keywords: Technology integration, pre-service teachers, Q methodology

Öğretmen Adaylarının Teknoloji Entegrasyonundaki Faktörlere İlişkin Algılarının Q Metodolojisi ile İncelenmesi

ÖZ

Bu çalışmanın amacı, öğretmen adaylarının Q metodolojisi ile teknoloji entegrasyonunu etkileyen faktörler ile ilgili perspektiflerinin anlaşılmasıdır. Araştırmaya bir devlet üniversitesinin eğitim fakültesinde öğrenim gören, 41 öğretmen adayı katılmıştır. Teknolojisi entegrasyonunu faktörleri yansıtan 12 ifade seçilmiştir. Q ifadelerinin belirlenmesinde, entegrasyon sürecinde öğretmen, kurumsal ve sistem, öğretmen tasarım düşüncesi ve öğrenci olmak üzere dört düzeyde ögelerin yer almasına dikkat edilmiştir. Veriler PQMethod 2.35 programı ile analiz edilmiştir. Faktör analizinde temel bileşenler analizi kullanılmış, döndürme işleminden sonra ve üç faktörlü çözüme ulaşılmıştır: (a) birey odaklı perspektif, (b) birey ve okul odaklı perspektif, (c) planlama, birey, okul ve sistem odaklı perspektif. Belirlenen bu perspektifler arasında öğretmenlerin mesleki gelişimlerinin desteklenmesi, teknoloji erişimi, öğrencilerin olumlu tutumları ve kılavuz kitapların teknoloji entegrasyonunu desteklemesi konusunda görüş birliği olduğu görülmüştür. Bununla birlikte, belirlenen üç faktördeki öğretmen adaylarının görüşlerinde farklılaşan alanlar olduğu görülmüştür. Birey odaklı perspektifteki öğretmen adaylarının öğretmenlerin teknolojinin eğitimdeki rolüne ilişkin değer inançlarına öncelik verdiği görülmüştür. Birey ve okul odaklı perspektifteki öğretmen adaylarının, öğretmenlerin teknolojik ve pedagojik yeterliklerine daha fazla önem verdikleri sonucuna ulaşılmıştır. Planlanma, birey, kurum ve sistem odaklı perspektifteki öğretmen adayları için öğretmenlerin teknoloji entegrasyonuna yönelik dersi planlamaları daha öncelikli bir etmen olduğu görülmüştür. Tanımlanan her bir perspektif için öğretmen eğitimcileri için öneriler sunulmuştur.
Anahtar kelimeler: Teknoloji entegrasyonu, öğretmen adayları, Q metodolojisi

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1 | INTRODUCTION

Technology integration is one of the most streamlined areas of research, reflecting the incredible speed of evolution of computer-based tools and applications (Bernard et al., 2018). Meta-analysis studies reveal the effect of using educational technologies in learning and teaching processes on learning performance (Chauhan, 2017; Cheung & Slavin, 2012; Higgins et al., 2019; Hillmayr et al., 2020). However, technology integration is a concept beyond the use of technology in learning and teaching processes. Belland (2009), defines technology integration, "as the sustainable and persistent change in the social system of K-12 schools caused by the adoption of technology to help students construct knowledge" (p. 354). In other words, technology integration is a sustainable change process beyond the use of educational technology in a short-term intervention. Therefore, many interrelated factors play a role in ensuring technology integration (Uslu & Usluel, 2019). Hew and Brush (2007) distinguished these factors into six groups: (a) resources (technology, access to available technology, time, and technical support), (b) knowledge and skills, (c) institutional, (d) attitudes and beliefs, (e) assessment, (f) subject culture. Based on the studies in the literature, Göktaş et al. (2009) listed the obstacles in the integration process as in-service training, software and hardware access, basic and integration knowledge and skills, time, managerial support and teaching programs. These factors are discussed as first-level (incremental, institutional) and second-level (fundamental, personal) barriers in Ertmer's (1999) highly cited study.

First-level factors include barriers outside the teacher such as equipment, time, training, and support. Access and technical support have been examined in many studies as an important determinant in the integration process (Pareja Roblin et al., 2018; Seifu, 2020). Even with adequate access to technology, effective professional development is seen as a major barrier to increasing the level of technology integration in classrooms (Harrell & Bynum, 2018). One of the external obstacles is the incompatibility between technology and the current curriculum and course hours (Gülbahar & Güven, 2008). In addition, administrative support at school level affects integration as first-level factors (Uslu & Usluel, 2019). Access to technology infrastructure, supportive school policies, and knowledge of how to integrate equipment effectively with course content are important prerequisites for sustainable practice (Pareja Roblin et al., 2018). School resources and environment have a strong influence on the practice of beginning teachers (Ottenbreit-Leftwich et al.,2018).

Initiatives to achieve integration primarily focus on increasing school access to technology. However, a three-year longitudinal study shows that access to technology increases, but teacher beliefs decline over time (Francom, 2020). In this context, second-level (personal) barriers become important. Second-level barriers are related to teachers' beliefs about learning and teaching, and their knowledge and skills (Ertmer, 1999; Hew & Brush, 2007). Teacher beliefs are defined as the most important obstacle for meaningful technology integration (Ertmer, 2005). The indirect and direct effects of technology value beliefs (Farjon et al.,2019; Uslu & Usluel, 2019) and pedagogical beliefs (Taimalu & Luik, 2019) on integration have been revealed in many studies. Also, one of the key factors at the teacher level is their core technological and integration-related competencies. Basic technology knowledge directly and indirectly affects technology integration (Ifinedo et al., 2020). In addition, teachers' technological, pedagogical and content knowledge and their intersection, TPACK knowledge, are one of the important determinants on integration (Habibi et al.,2020).

Tsai and Chai (2012) defined teachers' design thinking as a third-level barrier in addition to first- and second-order factors. Design thinking is the dynamic knowledge and practice created by teachers in the use of ICT in educational settings (Tsai & Chai, 2012). To broaden teachers' design thinking, it is important for teachers to prepare lesson plans that aim to integrate ICT into learning and teaching processes on the basis of effective pedagogical frameworks. Teachers' design thinking helps overcome perceptions of secondary barriers and can alleviate resource-based challenges (Makki et al.,2018).

The role of students' experiences, skills and motivations in the integration process should not be overlooked. Students' previous positive digital experiences significantly affect their perceived digital competence and attitudes towards digital technologies (Kim et al., 2018). Teachers make decisions about using technology in the classroom by considering how to effectively meet immediate teaching needs, beliefs about learning, and other contextual factors (Kopcha et al., 2020). In summary, the integration process includes the relations of many factors with each other.

Many studies have been conducted on the barriers perceived by teachers in the process of technology integration. Mercader and Gairin (2020) revealed that university teachers prioritized barriers such as lack of

education, lack of knowledge about digital technology teaching approaches, lack of planning, excessive workload, lack of time, generation gap, technophobia, lack of evaluation and incentives. In a study conducted with teachers in Indonesia, it was found that the lack of knowledge and experience in ICT education, in addition to the limited time and tools combined with poor Internet connection, are important barriers (Muslem et al., 2018). In a study conducted with physical education teachers, it was found that the loss of time spent on physical activity, lack of resources, investment in time and education, inappropriate use, lack of knowledge and technical problems are the most important barriers (Villalba et al., 2017). Kilinc et al. (2018) found that middle school social sciences teachers mostly stated that external factors such as limited technological opportunities, problems in Internet access, and methodical and technical support are barriers. As a result, in the literature, although more emphasis is placed on external factors, it is seen that there is a diversity regarding the barriers perceived by teachers, and the findings vary according to factors such as the level of the school and the subject area. On the other hand, the findings obtained by quantitative methods reflect the general tendencies of the study group. As a complement to objectivity, it is crucial to examine subjectivity in order to gather reliable evidence (Lundberg et al.,2020). Effective technology applications take place where complex factors converge (Heath, 2017). Considering that the factors in the integration process affect each other, it should be taken into account that there are various perspectives in prioritizing the perception of obstacles in the process. For educators who think that external barriers are more important, integration can be seen as a process that can be achieved with encouragement and support. On the other hand, a teacher who cares about teacher-level factors may find it difficult to develop solutions on how to overcome external obstacles, no matter how willing. Therefore, it is important to understand the perspectives of teachers and prospective teachers regarding the integration process. Understanding teachers' views on supporting and hindering factors in the integration process can also serve as a springboard for what steps to take in planning their future professional development. As a matter of fact, the factors that pre-service teachers prioritize can guide their future professional development trajectories. In this context, teacher educators' understanding of pre-service teachers' perspectives on barriers in the integration process can help them teach more effective courses that can support pre-service teachers from different perspectives.

In this study, it is aimed to understand the perspectives of pre-service teachers about the factors they perceive regarding the integration process through the Q methodology. Q methodology is seen as a window of obtaining information about subjective responses or reactions to problems encountered in educational research (Montgomery, 2010). With this method, it will be tried to take a step to understand the perspectives of teacher candidates on which factors affecting technology integration are more important and valuable, and to examine the areas where their views intersect and diverge.

2 | METHOD

Q METHODOLOGY

Q methodology is a systematic research method used to examine people's perspective or subjectivity (Maeder & Larwin, 2021). The purpose of a Q methodology study is to identify and categorize a specific group of participants' perspectives, personal structures, and values on a subjective topic, issue, or problem (Walker et al., 2018). This method allows understanding the convergence or divergence of participant perspectives, including which aspects of the domain are of value and importance for individuals in the field (Rodl et al.,2020). In this study, it is aimed to understand the viewpoints of prospective teachers about the factors affecting technology integration. The steps suggested by Rieber (2020) were followed in conducting the Q study (Figure 1).

In the first stage, the intention of the research and the suitability of the q methodology were evaluated. In this context, the study focuses on understanding pre-service teachers' views on technology integration. The individual's perceptions of the factors affecting integration have characteristics that bring about subjective opinions that can vary from person to person.

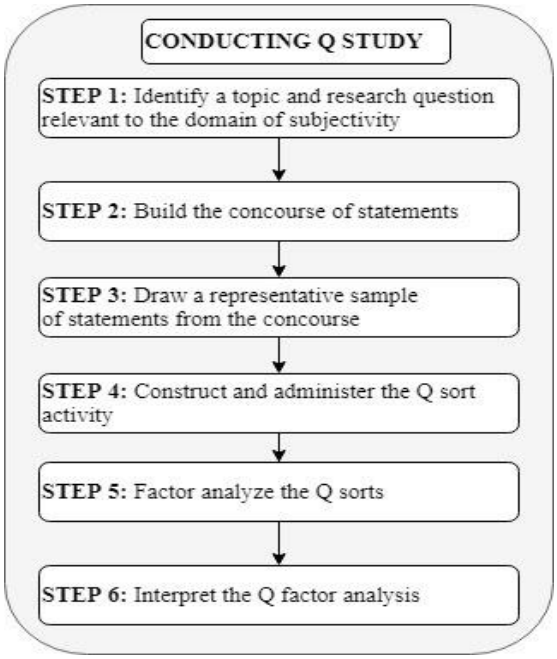

Figure 1. *A Step-by-step Approach to Conducting a Q Study (Rieber, 2020).*

Before performing the Q activity, the pre-service teachers participated in the discussion sessions in order to gain an understanding of the factors affecting the integration process in the instructional technologies course. In the second stage, the expressions in the Q sorts were selected. For this, studies on the factors affecting the integration process in the literature were used. In this context, the study by Kaya and Usluel (2011) in which the articles on technology integration using structural equation modelling or regression analysis were analysed by content analysis was used. In addition, the items in the measurement tool developed by Uslu (2013) to examine teachers' perceptions of barriers in the process of technology integration were used. In the third stage, expressions were chosen to reflect their perspectives on the factors affecting the integration process. In determining the Q sorts, attention was paid to include expressions at four levels: teacher, institutional and system, teacher design thinking and student in the integration process. The selected 12 statements are given in Table 1.

Table 1. Q Statements

Classification	Statements
School and system level factors (First -order)	1. The school has a budget to ensure technology integration
	2. Education policies at the country level encourage technology integration
	3. Lack of computers, projectors, smart boards and internet in classrooms
	4. Inadequate professional development programs given to teachers on technology integration
	5. Not including activities related to the use of technology in the lessons in the guidebooks given to the teachers.
	6. School administration's support of teacher's efforts towards technology integration
Teacher level factors (Second-order)	7. The teacher has positive attitudes and beliefs about the use of technology in teaching.
	8. The teacher has sufficient technological and pedagogical knowledge to integrate technology
	9. The teacher has student-centered pedagogical beliefs and approaches.
Third-order factors	10. Teacher's lesson planning for technology integration
Student-level factors	11. Students have sufficient digital skills
	12. Students have negative opinions about the use of technology in the lesson

In the fourth step, the Q sort activity was applied to the teacher candidates in an electronic environment with a document prepared in MS word. The document consists of three parts: Q sorts, grid and an open-ended question in which pre-service teachers can write their reasons for the order they have made. Before the application, pre-service teachers were explained about how to do the Q sort activity. The grid used for the sorting process is presented in Figure 2.

<table>
<tr><td>It has a rather negative impact on technology integration.</td><td></td><td></td><td></td><td>It has a rather positive impact on technology integration.</td></tr>
<tr><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td></tr>
<tr><td>1 statement</td><td></td><td></td><td></td><td>1 statement</td></tr>
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</table>

Figure 2. *Q Sorting Grid*

In the fifth step, the correlations of the participants' Q sorts are calculated and factor analysis of these correlations is made on a per-person basis (Rieber, 2020). In the sixth step, the resulting clusters are interpreted and defined.

DATA COLLECTION AND ANALYSIS

Forty-one pre-service teachers studying at the faculty of education of a state university participated in the research. The participants are 2nd and 3rd year students taking the instructional technologies course. Twenty-three of the pre-service teachers were female and eighteen were male. Participants are studying in the department of science education, guidance and psychological counseling studies, social science education. After the necessary explanations about the Q Sorting grid were given to the teacher candidates. The application was made in a period of 20-30 minutes. Afterwards, pre-service teachers answered an open-ended question about how and for what reasons they do Q sorting.

In this study, q sorts were analyzed with the free software PQMethod (Schmolck, 2014). Q factor analysis creates factors by grouping highly correlated Q types together (Sung & Akhtar, 2017). In data analysis in the Q methodology, individuals are treated as a variable and factor analysis is performed to produce statistically significant groupings that suggest similar perspectives on the study topic (Walker et al.,2018). The purpose of factor analysis in the Q methodology is to reduce the number of different perspectives from the total number of participants to fewer related or like-minded groups (Rieber, 2020). Principal component analysis was used in the factor analysis, and a three-factor solution was obtained after the rotation process.

3 | FINDINGS

FACTOR ANALYSIS

As a result of the Q factor analysis, three clusters emerged reflecting the views of pre-service teachers on the factors affecting technology integration. The factor distributions as a result of principal component analysis and rotation are presented in Table 2.

Table 2. Participant Factor Loadings

Participant	Factor A (N=21)	Factor B (N=7)	Factor C (N=7)	Participant	Factor A (N=21)	Factor B (N=7)	Factor C (N=7)
Student 1	**0.7559X**	0.4463	0.3860	Student 22	**0.7152X**	0.3568	0.0856
Student 2	0.4574	0.2314	**0.8022X**	Student 23	**0.5715X**	0.5072	0.4006
Student 3	0.4356	**0.6734X**	0.5116	Student 24	**0.6767X**	0.4979	0.2926
Student 4	**0.7595X**	0.1287	0.4533	Student 25	**0.7328X**	0.4354	0.3864
Student 5	0.5303	0.1423	0.5580	Student 26	0.4958	0.5624	0.4920
Student 6	0.2211	**0.8021X**	0.4069	Student 27	**0.7317X**	0.1581	0.1278
Student 7	**0.8496X**	0.4196	0.2586	Student 28	0.2503	0.3197	**0.8471X**
Student 8	**0.8496X**	0.4196	0.2586	Student 29	0.2503	0.3197	**0.8471X**
Student 9	**0.6674X**	0.5890	0.2827	Student 30	0.4505	**0.7454X**	0.3882
Student 10	0.4191	**0.7292X**	0.1647	Student 31	**0.6986X**	0.4003	0.5074
Student 11	**0.7582X**	-0.1435	0.5069	Student 32	**0.8120X**	0.3730	0.3921
Student 12	0.4857	0.4866	0.4929	Student 33	0.0787	0.1975	**0.6910X**
Student 13	0.6166	0.5755	0.3216	Student 34	**0.7956X**	0.2921	0.4763
Student 14	**0.7053X**	0.4329	0.4246	Student 35	0.3399	**0.7213X**	0.0934
Student 15	**0.7871X**	0.4784	0.1723	Student 36	0.4530	0.0544	**0.7890X**
Student 16	0.4761	0.5282	0.5886	Student 37	**0.6288X**	0.3189	0.3828
Student 17	0.3997	0.4636	0.6083	Student 38	0.2893	0.3684	**0.6405X**
Student 18	0.1928	0.5462	**0.7250X**	Student 39	**0.7956X**	0.2921	0.4763
Student 19	0.5196	0.5827	0.4929	Student 40	**0.7139X**	0.1592	0.5036
Student 20	**0.6986X**	0.4003	0.5074	Student 41	**0.6252X**	0.4228	0.4184
Student 21	0.1487	**0.6386X**	0.5554				

According to Table 2, 21 of the pre-service teachers participating in the research took place in the Factor A, seven in the Factor B, and seven in the Factor C. Six pre-service teachers were not significantly included in the three factors.

FACTOR A: INDIVIDUAL ORIENTED PERSPECTIVE

The opinions of the pre-service teachers classified in Factor A regarding the statements they accepted and did not accept are given in Table 3. According to Table 3, it is seen that the pre-service teachers in this factor attach more importance to the factors at the individual level. According to the pre-service teachers classified in Factor A, the most important condition that positively affects technology integration is that the teacher has positive value beliefs about the use of technology in education. In addition, they think that teachers have sufficient technological and pedagogical knowledge to integrate technology, have student-centered pedagogical beliefs, and students have digital skills are other factors that positively affect technology integration.

According to the pre-service teachers included in this factor, the most important condition that negatively affects technology integration is the lack of access to technology in the classrooms. In addition, they think that factors such as the limited professional development opportunities given to teachers, the teacher's guidebooks do

not include technology use, and students have negative opinions about technology use in the lesson, affect technology integration negatively. They have neutral views on education policies, budget, school support and teacher's lesson planning. The opinions of the pre-service teachers in this factor regarding the reasons for the Q ranking they made are as follows:

"*First of all, I think that the most important person in the factors affecting technology integration is the teacher. In fact, it is much more important than the country's education policy and support from the school. Because there are neither country ministers nor school administrators in front of the students in the classroom. There is only the teacher and his ideas about technology and education. Therefore, in my opinion, the inadequacy of technology integration education in teacher training is the biggest problem."* (Student 21).

Table 3. Most Agreed and Most Disagreed Statements of Pre-Service Teachers in Factor A

Statement	Z score	Grid position
7. The teacher has positive attitudes and beliefs about the use of technology in teaching.	1.925	+2
8. The teacher has sufficient technological and pedagogical knowledge to integrate technology	0.948	+1
9. The teacher has student-centered pedagogical beliefs and approaches.	0.641	+1
11. Students have sufficient digital skills	0.399	+1
2. Education policies at the country level encourage technology integration	0.374	0
10. Teacher's lesson planning for technology integration	0.250	0
1. The school has a budget to ensure technology integration	0.141	0
6. School administration's support of teacher's efforts towards technology integration	0.113	0
4. Inadequate professional development programs given to teachers on technology integration	-0.920	-1
5. Not including activities related to the use of technology in the lessons in the guidebooks given to the teachers.	-0.985	-1
12. Students have negative opinions about the use of technology in the lesson	-0.988	-1
3. Lack of computers, projectors, smart boards and internet in classrooms	-1.673	-2

"I placed the teacher's belief in technology as the most positive effect, because in my opinion, everything happens or doesn't happen at will. If the teacher really wants to use technology actively, he does not need the support of the administration or the country. He can also benefit from technology with his own efforts. The biggest obstacle to teachers on this path is students. If the students are not in favor of technology, no matter how hard the teacher tries, he cannot make the student like technology. The first thing to do is to soften the student's thoughts towards technology. I don't think the teacher needs any support. That's why I put the state and administration's technology support to neutral effect." (Student 11).

"For me, the most important factor in technology integration is the teacher's belief that technology is necessary. Because if the teacher considers the use of technology as unimportant, an efficient technology cannot be used in that lesson. If the teacher is willing, he or she will somehow make up for the lack of knowledge, even if his knowledge is insufficient. Since technology is a constantly changing field, information becomes insignificant over time if there is no desire to be renewed, and if there is a desire, it is renewed gradually over time. If students or teachers do not have a negative opinion about the use of technology, these technologies will certainly be used efficiently." (Student 15).

FACTOR B: INDIVIDUAL AND SCHOOL ORIENTED PERSPECTIVE

The opinions of the pre-service teachers classified in Factor B regarding the statements they accepted and did not accept are given in Table 4.

Table 4. Most Agreed and Most Disagreed Statements of Pre-Service Teachers in Factor B

Statement	Z score	Grid position
8. The teacher has sufficient technological and pedagogical knowledge to integrate technology	1.717	+2
6. School administration's support of teacher's efforts towards technology integration	0.978	+1
1. The school has a budget to ensure technology integration	0.830	+1
7. The teacher has positive attitudes and beliefs about the use of technology in teaching.	0.640	+1
9. The teacher has student-centered pedagogical beliefs and approaches.	0.588	0
2. Education policies at the country level encourage technology integration	0.064	0
11. Students have sufficient digital skills	0.000	0
10. Teacher's lesson planning for technology integration	-0.161	0
5. Not including activities related to the use of technology in the lessons in the guidebooks given to the teachers.	-0.836	-1
3. Lack of computers, projectors, smart boards and internet in classrooms	-1.129	-1
12. Students have negative opinions about the use of technology in the lesson	-1.232	-1
4. Inadequate professional development programs given to teachers on technology integration	-1.459	-2

According to Table 4, it is seen that the pre-service teachers in this factor have opinions about the necessity of school support and budget, as well as the teachers' competencies and positive beliefs about the use of technology. In addition, according to pre-service teachers, the most important condition that positively affects technology integration is that the teacher has sufficient technological and pedagogical knowledge to integrate technology. At the same time, they think that elements such as training for teachers, teacher guidebooks, technology opportunities in classrooms, and students' negative opinions about technology use in the lesson affect technology integration negatively. According to the pre-service teachers included in this factor, the most important condition that negatively affects technology integration is the lack of support for teachers' professional development. Teachers have neutral views on student-centered pedagogical beliefs, country-level education policies, students' digital skills, and teacher's lesson planning for technology integration. The opinions of the pre-service teachers in this factor regarding the reasons for the Q ranking they made are as follows:

"I think the most important factor is that the teacher has sufficient technological and pedagogical knowledge and can reflect this to the lesson. The fact that students have this knowledge and participate in the course together affects the course positively. Inadequate technological and pedagogical knowledge of the teacher and the inability to receive support in this regard also prevent the delivery of modern education and training. One of the important obstacles is that the school does not have enough technology. Because not having it at the point where technology will be most beneficial will cause many benefits to be avoided. For this reason, the school should have the support and the budget to allocate it." (Student 10).

"In my opinion, the situation that most positively affects technology integration is that teachers have sufficient pedagogical and technological knowledge in this field. Because the teacher is the person who will guide the students and encourage them to use technology in the lesson. If the teacher has sufficient knowledge, he can transfer this knowledge to his students. When I think in this direction, the situation that most negatively affects technology integration is the inadequacy of in-service training given to teachers. Since the teacher is the person who plays the most active role in the lesson and plans the lesson, it is necessary to provide the teachers with sufficient equipment for technology integration. The more quality education is given to the teacher on this subject, the more conscious the use of technology in the lessons will be. Therefore, it is very important to provide professional development opportunities." (Student 21).

FACTOR C: PLANNING, INDIVIDUAL, SCHOOL AND SYSTEM ORIENTED PERSPECTIVE

The opinions of the pre-service teachers classified in Factor B regarding the statements they accepted and did not accept are given in Table 5.

Table 5. Most Agreed and Most Disagreed Statements of Pre-Service Teachers in Factor C

Statement	Z score	Grid position
10. Teacher's lesson planning for technology integration	1.374	+2
8. The teacher has sufficient technological and pedagogical knowledge to integrate technology	1.073	+1
2. Education policies at the country level encourage technology integration	1.024	+1
1. The school has a budget to ensure technology integration	0.984	+1
7. The teacher has positive attitudes and beliefs about the use of technology in teaching.	0.299	0
9. The teacher has student-centered pedagogical beliefs and approaches.	0.000	0
11. Students have sufficient digital skills	-0.016	0
6. School administration's support of teacher's efforts towards technology integration	-0.128	0
12. Students have negative opinions about the use of technology in the lesson	-0.854	-1
4. Inadequate professional development programs given to teachers on technology integration	-0.984	-1
5. Not including activities related to the use of technology in the lessons in the guidebooks given to the teachers.	-1.000	-1
3. Lack of computers, projectors, smart boards and internet in classrooms	-1.772	-2

According to the pre-service teachers in Factor C, the most important condition that positively affects technology integration is that the teacher plans the lesson for technology integration. According to the pre-service teachers included in this factor, teachers' having technology and pedagogical competencies, country-level education policies and school support positively affect technology integration. Technology access and opportunities in the classrooms are the most important conditions that negatively affect technology integration. In addition, students' negative opinions about the use of technology in the lesson, insufficient professional development opportunities, and the absence of technology use in teacher's guidebooks affect integration negatively. Pre-service teachers in Factor C have neutral opinions about teachers' positive value beliefs regarding the use of technology in education, student-centered pedagogical beliefs, students' digital skills, and administrative support. The opinions of the pre-service teachers in this factor regarding the reasons for the Q ranking they made are as follows:

"In order not to experience any difficulties during the semester, the teacher should prepare the plan accordingly and be equipped with sufficient equipment. The fact that the teacher is knowledgeable about technology will also give confidence to the student. I think that the student's aptitude for technology is not important. Likewise, I added it to the neutral effect section, as I do not think that the teacher's student-centered beliefs and approaches have neither a positive nor a negative effect on technology integration." (Student 28).

"In schools, the teacher determines how the lesson will be taught, the lesson plan and the technology to be used. If he wants to teach a technology-based course in the lesson, he makes the plan accordingly, so that new technologies are taught to the students and the student develops himself by using technology. Of course, I made my assessment by taking into account the importance given to technological integration by the country and the school and their valuable assistance. I think it is important for the country-level policies and the school to have the necessary budget. If it is supported at the country level, studies on these are included in schools and events are also held. In addition, a better education is achieved when the teachers have sufficient technological and pedagogical knowledge and the students have digital competence. Actually, of course, this ranking has a positive or negative effect, but I think that beliefs and approaches are a bit more in the background compared to others. The lack of computers, projectors, smart boards and the internet in the classrooms with the most negative impact, if there is no technology in the classroom, activities cannot be done for this and students cannot have technology-related competences." (Student 38).

CONSENSUS IN STATEMENTS

It was seen that teacher candidates had similar views in five of the twelve statements. Statements with consensus are given in Table 6.

Table 6. Consensus Statements

	Factor A	Factor B	Factor C
11. Students have sufficient digital skills	+1	0	0
3. Lack of computers, projectors, smart boards and internet in classrooms	-2	-1	-2
4. Inadequate professional development programs given to teachers on technology integration	-1	-2	-1
5. Not including activities related to the use of technology in the lessons in the guidebooks given to the teachers.	-1	-1	-1
12. Students have negative opinions about the use of technology in the lesson	-1	-1	-1

The participants think that the use of technology in the guidebooks given to the teachers and the negative opinions of the students about the use of technology in the lesson have a negative effect on the integration. In addition, teachers have similar views on the limitations of professional development opportunities for technology integration (-1, -2, -1) and the lack of access to technology in classrooms (-2, -1, -2). It is seen that there is a consensus regarding the sufficient digital skills of the students (+1, 0, 0).

DIVERGENCE IN STATEMENTS

Differential expressions for all three perspectives are given in Table 7. When Table 7 is examined, it is seen that there are different perspectives regarding the statements about the teacher.

Table 7. Distinguishing Statements

	Factor A	Factor B	Factor C
7. The teacher has positive attitudes and beliefs about the use of technology in teaching.	+2**	+1	0
8. The teacher has sufficient technological and pedagogical knowledge to integrate technology	+1	+2*	+1
10. Teacher's lesson planning for technology integration	0	0	+2**
9. The teacher has student-centered pedagogical beliefs and approaches.	+1*	0	0
1. The school has a budget to ensure technology integration	0**	+1	+1
6. School administration's support of teacher's efforts towards technology integration	0	+1**	0
2. Education policies at the country level encourage technology integration	0	0	+1**

***** p<.05 ; ** p< .01

It is seen that the pre-service teachers in Factor A score +2 for the expression that the teacher has positive attitudes and beliefs about the use of technology in education. While Factor B considers this statement to be important, participants in Factor C have neutral opinions. While it is the most important expression for Factor B that teachers have technological and pedagogical competencies to be able to use technology; Factor A and Factor C scored this statement +1. Teachers' lesson planning for technology integration is the most important supporting condition for pre-service teachers in Factor C. On the other hand, participants in Factor A and Factor B have neutral opinions on this issue. While teachers' having student-centered pedagogical beliefs is a neutral condition for Factor B and Factor C, it is one of the conditions that positively affect integration according to pre-service teachers in Factor A.

While Factor A had a neutral opinion in the statement that the school has a budget to provide technology integration, those in Factor B and Factor C scored +1. Although the school administration's support of the teacher's efforts towards technology integration is in a neutral position for Factor A and Factor C, teacher candidates in Factor B rated as +1. While pre-service teachers in Factor C rated country-level policies for technology integration as +1; It was seen that those in Factor A and B had a neutral opinion on this issue.

4 | DISCUSSION

This study focused on understanding pre-service teachers' perspectives on the factors affecting technology integration. As a result of the Q factor analysis, three clusters related to technology integration emerged. Pre-service teachers in Factor A think that teachers' technology-related value beliefs, pedagogical beliefs, competencies and student skills are factors that positively affect technology integration. While the pre-service teachers in this factor accept that the lack of access to technological tools in the classrooms is an important obstacle; they are of the opinion that teachers' having positive value beliefs is an important condition for overcoming obstacles in the integration process. Teachers' value beliefs are an important factor in overcoming first-level barriers (Ertmer et al., 2012). Also, teachers' value beliefs moderate their perceptions of school support (Vongkulluksn et al., 2018). According to the pre-service teachers in this factor, if the teacher believes that technology is necessary in educational processes, he can take the necessary steps to have the necessary pedagogical and digital skills. In the literature, it has been found that value beliefs, pedagogical beliefs and competencies are related (Cheng et al., 2021). Technology value beliefs affect perceived knowledge of technology integration (Taimalu & Luik, 2019) and TPACK (Cheng & Xie, 2018). Therefore, there are findings in the literature that beliefs are the precursors of skills. It has been observed that the teachers included in Factor A regarding the statements that negatively affect the integration process think that the absence of technology use in the guidebooks

and the inadequacy of professional development activities for integration are important obstacles. However, teachers have neutral views on preparing lesson plans for technology integration. On the other hand, the use of ICT before the lesson is an important precursor to the use of ICT in the classroom (Uslu & Usluel, 2019). Even if teachers have positive value beliefs about technology and have the necessary pedagogical and digital competencies, their failure to make a pre-lesson planning can hinder the process.

According to the pre-service teachers in Factor B, the most important factor supporting technology integration is the teacher's pedagogical and technological competencies. Technological and pedagogical competencies of teachers are one of the important determinants in the integration process. While technological competences affect pedagogical competences, pedagogical competences also affect the use of technology in the classroom (Suárez-Rodríguez et al.,2018). Unlike Factor A, pre-service teachers in this cluster also care about school support and budget, among the factors that positively affect technology integration. In the literature, it has been found that administrative support has indirect and direct effects on teachers' competencies (Baharuldin et al., 2019). Similarly, according to the pre-service teachers in factor B, the most important obstacle is that teachers are not supported with professional development opportunities in technology integration. Therefore, according to pre-service teachers in Factor B, teachers' having the necessary competencies and not providing professional development opportunities to achieve this affects the integration process.

According to the pre-service teachers included in Factor C, the most positive factor affecting the integration process is the teachers' planning of the lesson in a way that will ensure integration before the lesson. There are many studies in the literature that focus on teacher and pre-service teachers' course design to ensure integration (Koh et al., 2017; Murthy et al.,2015; Rienties et al.,2013; Uslu & Usluel, 2016). In addition to lesson planning, pre-service teachers in this factor think that teachers' technological and pedagogical competencies, country-level policies and school budget are the conditions that support integration. Therefore, it can be said that teacher candidates in this factor attach importance to factors at planning, teacher, school and country level in the integration process. On the other hand, it was seen that the pre-service teachers in this cluster had neutral views about teachers' value beliefs and pedagogical beliefs. Their answers to open-ended questions about their reasons for the Q sorting process also support this situation. The pre-service teachers in this factor gave more importance to planning than beliefs and attitudes. It can be interpreted that they handle the process through more measurable and visible indicators. On the other hand, according to Vongkulluksn et al. (2018), value beliefs also mediated and moderated the relationship between how teachers' perceived support for first-order barriers affected both the quantity and quality of technology integration.

It is seen that there is a consensus among Factors A, B and C on the importance of including the use of technology in the guidebooks and supporting the professional development of teachers. In this context, it can be said that they have similar views on the factors that hinder technology. It has been determined that there is a consensus on the need for students to have digital skills and to have important opinions about their use in lessons and the necessity of technology infrastructure in the classrooms. However, it has been seen that there are different perspectives on the factors that have a neutral effect of factors A, B and C. While pre-service teachers in Factor A think that school support, school budget and education policies at the country level have a neutral effect; Factor B thinks that school administration, and Factor C thinks that education policies at the country level have a positive effect. It has been concluded that there are differentiating perspectives on the conditions that positively affect the integration. It was found that those in Factor A prioritized technology value beliefs, those in Factor B prioritized competencies, and those in Factor C prioritized lesson planning. Therefore, the reasons why teachers have different perceptions between the conditions that support technology integration emerges as an area that needs to be examined in the future.

IMPLICATIONS

In this study, it was seen that pre-service teachers had different perspectives on the factors affecting technology integration. Teacher educators need to be aware of the different perspectives of pre-service teachers, be open to their diversity in their views, and raise awareness about the factors affecting integration. The integration process is a complex process involving many interrelated factors. Therefore, it seems more likely that pre-service teachers plan their professional development on the conditions that they care more about. However, teacher educators have important duties to increase and strengthen the awareness of prospective teachers by considering all the elements

in the process. The majority of pre-service teachers who participated in the study saw technology access in classrooms as a major barrier. There was also variation in the prioritization of factors at the teacher level. It was seen that the pre-service teachers who prioritized the factors at the individual level gave more importance to the beliefs of the teachers. Therefore, it would be beneficial to increase the awareness of teacher candidates with this perspective on barriers at school, system and student level. For this, these pre-service teachers can be provided to work on case studies that will make them think about how to overcome obstacles at school level. Considering that integration is a long-term sustainable change process, they should be helped to gain insight into how they can overcome external obstacles in the process. It was observed that pre-service teachers in Factor B prioritized conditions at school and teacher level, but had neutral views on policies at the country level. Sessions on technology integration policies of different countries can be organized in order to raise awareness of pre-service teachers in this group about the reflection of system-level policies on the integration process. In addition, it was observed that the pre-service teachers who had an individual-level (Factor A) and an individual and system-oriented perspective (Factor B) had neutral views about the teacher's lesson planning. It is necessary for pre-service teachers to gain awareness about the importance of planning and preparation phase in the integration of technology into the learning and teaching process. Teacher candidates in Factor C, on the other hand, had neutral views on the role of teachers' technology value beliefs and pedagogical beliefs. Considering that teacher beliefs are resistant to change and affect classroom practices, it is recommended that these pre-service teachers be aware of their existing beliefs and participate in learning activities about how they affect the practice process.

LIMITATIONS AND RECOMMENDATIONS

In this study, it has been tried to understand the viewpoints of the pre-service teachers regarding the preventive and supportive conditions regarding the technology integration process. The findings of the study are limited to the pre-service teachers participating in the research. The pre-service teachers who participated in the study attended a course in which they made theoretical knowledge and applications about the integration process. Therefore, a study that will take place with the participation of teacher candidates studying in different faculties can reach more diverse perspectives. Also, future research could focus on understanding the perspectives of in-service teachers and examine the comparison of these perspectives with pre-service teachers. In addition, future research may focus on understanding perspectives on how factors at the teacher, school-system, and student level in the integration process affect each other.

5 | CONCLUSION

Technology integration is one of the ultimate goals of many education systems. Although it is accepted in the studies that the teachers do not include the desired level of ICT in their lessons and that they mostly hang out on external conditions, it can be considered promising that the teacher candidates who participated in this study mostly emphasized the skills, belief and lesson planning processes at the teacher level. Therefore, this situation can be considered as a step for pre-service teachers to have proactive approaches in the process of integrating technology in future teacher practices. Although different factors related to the factors in the integration process have been prioritized, teacher education has an important place in shaping the intentions of pre-service teachers to integrate technology in their future classroom practices. Therefore, it is important to consider different perspectives for future teachers to gain awareness of the obstacles they will face, understand their own strengths and weaknesses, and increase their readiness for technology integration as they become teachers.

RESEARCH ETHICS

Participants were informed about the data collection and analysis process before participating in this study. In addition, they signed the consent forms indicating that they agreed to participate in the study. The collected data and the information of the participants are kept confidential. Ethical approval certificate were given from Manisa Celal Bayar University Social and Human Sciences Ethics. Ethics committee document number is E--050.01.04-202065.

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