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The effect of preservice teachers' experiences in a flipped course on digital competencies related to educational technology and innovativeness

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Highlights

- Preservice teachers' digital competencies and innovativeness significantly improved after the flipped course.
- Most of the preservice teachers were either early majority or early adopters before the flipped course.
- Most of the preservice teachers were in the category of early adopters after the flipped course.
- The most common themes were using Web 2.0 tools for teaching, acceptance of flipped learning, doing research, and gaining different perspectives.

Article Info: Research Article

Keywords: Flipped learning, digital competence, innovativeness, preservice teachers

Abstract

Developing the digital competencies and innovativeness of preservice teachers enables them to utilize technology more effectively and efficiently in their future professional life. However, poor technology training can lead preservice teachers to potentially misuse technology in the classroom. Moreover, little is known about how to design effective technology training courses in order to develop the digital competencies and innovativeness of preservice teachers. Therefore, this study examined a course designed with the flipped learning approach and its impact on preservice teachers' digital competencies and innovativeness. 58 students participated in the current study. Using a mixed-methods sequential explanatory design, changes in digital competencies and innovativeness were analyzed before and after the flipped course. Findings revealed statistically significant gains in preservice teachers' digital competencies and innovativeness, and qualitative findings revealed the reasons for these gains. The most common themes were using Web 2.0 tools for teaching, acceptance of flipped learning, doing research, and gaining different perspectives. Based on these findings, it is argued that the use of flipped learning approach removed the time barrier in classes and enabled teachers to gain experience on effective technology usage through actual physical application. The study's results provided recommendations for further research on the connection between flipped learning and the development of preservice teachers' digital competencies and innovativeness.

1. Introduction

Today's teachers are expected to be effective users of new technologies in education (Organisation for Economic Co-operation and Development [OECD], 2010), with such new technologies helping many professionals to perform their jobs more efficiently and more effectively. However, this change is rarely applied to classroom teachers (Ertmer & Ottenbreit-Leftwich, 2010). Deficient integration of technology into learning environments is based on many different reasons such as insufficient access to technology (Dawson, 2008), lack of available time (Wepner et al., 2003), lack of technology-based skills (Teo, 2009), unfamiliarity with the most innovative technology applications (Elmalı & Balkan Kıyıcı, 2022), computer experience, and information, as well as attitudes towards technology (ICT), improper pedagogical approach

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of teacher educators, and a lacking in teachers' characteristics such as personal entrepreneurialism (Drent & Meelissen, 2008). These reasons can be divided into two categories: external and internal barriers. External barriers include accessibility to technology hardware, software, resources, and training (Rowston et al., 2021). On the other hand, internal barriers involve competencies, beliefs, confidences, and attitudes towards technology integration in educational settings (Tondeur et alç, 2017; Makki et al., 2018). Current evidence shows that access to digital tools is less important for students' learning than how teachers use them across subjects (Aflalo et al., 2017; Baker et al., 2018; Blikstad-Balas & Davies, 2017). It is also mentioned that confidence and competence limitations are referred as the most common inhibitors of technology practice (Ottenbreit-Leftwich et al., 2018; Sadaf et al., 2016). In addition, educational technology use usually depends how the teachers' readiness for their ability to integrate in their instruction (OECD, 2016). Irrespective of readiness level, innovativeness is crucial for technology use (Almusawi et al., 2021). Thus, the current study focuses on two factors that related to internal barriers and are supposed to result in the ineffective integration of technology into learning environments: digital competencies, and innovativeness.

In order to develop preservice teachers' digital competences and innovativeness, the flipped learning strategy was selected as a pedagogical approach because this approach helps to increase the amount of available time in the classroom (Filiz & Kurt, 2015). By doing so, students can be exposed to a variety of activities that meet with Bloom's higher stages such as apply, analyze, evaluate, and create within the classroom to apply their newly gained knowledge (Fraga & Harmon, 2014). In many studies that have aimed to improve the digital competencies of preservice teachers, multiple strategies have been employed, with most designed within the traditional classroom-based teaching setting where preservice teachers first learn in class and then apply their learned knowledge in a limited time within the class or outside of the classroom.

In the literature, limited numbers of studies have used flipped learning as a course design approach to improve the digital competencies of preservice teachers. Flipped learning, which is considered to be a new learning approach was chosen as the learning approach of the current study because it encourages students to take responsibility for their own learning and helps to free up class time to let them experience instructional strategies during the application of learned course content (Vaughan, 2014). As Polly et al. (2010) indicated, without preservice teachers witnessing firsthand how technology can be effectively integrated into the classroom, they will likely only acquire basic technology-based skills. By freeing up in-class time, the flipped learning approach may help preservice teachers to learn how they can effectively integrate technology into the classroom. In the current study, multiple teaching strategies as described in the literature review are used to improve the digital competencies of preservice teachers that may be considered well-matched to the flipped learning approach thanks to the increased amount of learning time they receive in the class.

2. Literature

2.1. Digital Competence

According to Ferrari (2013), digital competence is the set of knowledge, skills, attitudes, abilities, strategies, and awareness necessary to utilize ICTs and digital media to communicate, collaborate, create, and share content; and to build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, and reflectively for the purposes of work, leisure, participation, learning, and socializing. Krumsvik (2012) narrowed this definition down for preservice teachers and teachers since digital competences differ from that of other individuals as the focus is on how to use technology for teaching and learning rather than everyday use or entertainment. Røkenes and Krumsvik (2014) then defined digital competence for preservice teachers as their proficiency in using ICTs within a professional context, with good pedagogical and didactic judgment, and the awareness of its implications for learning strategies.

Several frameworks have been developed to define the digital competencies of teachers (International Society for Technology in Education [ISTE], n.d.; Ferrari, 2013). For example, the ISTE developed a framework that defined the digital-age skills and pedagogical insights that educators need to teach, apply, and learn (ISTE, 2016). Towards this, in 2008 the ISTE developed the National Educational Technology Standards for Teachers which determined the skills needed by teachers for effective teaching in the 21st century. These standards include five core competency areas, which are: (1) facilitate and inspire student learning and creativity; (2) design and develop digital-age learning experiences and assessments; (3) model digital-age work and learning; (4) promote and model digital citizenship and responsibility; and (5) engage in professional growth and leadership (ISTE, n.d.). The ISTE's National Educational Technology Standards for Teachers revealed the expected competencies from teachers in the digital age.

Although different digital competence frameworks have been developed by various associations and academic researchers, there is still a need for further studies to be conducted that include digital competence training for preservice teachers (Ramírez-Montoya et al., 2017; Røkenes & Krumsvik, 2014; Tømte et al., 2015). As has been highlighted in the literature, technology is often misused by preservice teachers (Chien et al., 2012) due to their having received poor technology-based training during their preservice teacher education (Çuhadar, 2018; Gudmundsdottir & Hatlevik, 2017), and it seems that only a small number of new graduate teachers are able to use technology in various and flexible ways so as to truly create a student-centered learning environment (Bang & Luft, 2013; Gao et al., 2011). Many teacher training institutions have attempted to develop preservice teachers' technology competencies through introductory educational technology courses (Polly et al., 2010), but the innovative use of technology in the classroom lags significantly behind expectations (Lim et al., 2011; Uerz et al., 2018). New approaches need to be established in order to teach preservice teachers how technology should intersect with both pedagogical and content knowledge (Admiraal et al., 2016; Mouza et al., 2014; Zhao et al., 2021).

2.2. Strategies Used to Improve Digital Competencies of Preservice Teachers

Over the past decade, numerous empirical studies have focused on the technology training of preservice teachers, with different strategies used by teacher educators to train preservice teachers in the use of technology aimed towards their future in the teaching profession. A literature review performed by Røkenes and Krumsvik (2014) assessed some of the different strategies employed by teacher educators, and from a review of 42 articles, they identified eight approaches that had been used for the development of preservice teachers' digital competencies (co-operative learning, reflective practice, blended learning, modeling, authentic learning, student-active learning, assessment, and bridging theory/practice gap). Similar approaches were also identified by Tondeur et al. (2012) where 12 key themes were identified from a review of 19 qualitative studies that had focused on strategies to prepare preservice teachers to integrate technology into their lessons. Some of the most recurrent themes identified in their review were scaffolding, aligning theoretical and practical knowledge through the use of ICT, and the use of modeling by teacher educators.

Both the literature reviews conducted by Røkenes and Krumsvik (2014) and Tondeur et al. (2012) included certain important implications for teacher education. For instance, modeling is an effective motivator for preservice teachers to integrate technology into their own teaching practices because observing a teacher using technology has proven to positively impact preservice teachers (Haydn & Barton, 2007). Another important implication is bridging the theory-practice gap; whereas rather than simply aiming to improve tool-based knowledge, the conceptual or theoretical knowledge should in fact be linked to practical applications (Tømte, 2015). As Uerz et al. (2018) stated, to improve preservice teachers' digital competencies, teacher educators need to do more than just model technology usage but need to use technologies in constructive ways when teaching course content (Koehler et al., 2013).

It is also important to ensure that preservice teachers are afforded the opportunity to understand the pedagogical reasons to use technology in their teaching (Tondeur et al., 2016). One way to achieve that is their reflecting on the role of technology in education. Preservice teachers could be tasked to reflect the

role of technology in education through discussion or reflection which could be in various forms, i.e., both offline and online such as online discussion or a reflective diary (Røkenes & Krumsvik, 2014; Tondeur et al., 2012). Through reflecting, preservice teachers could likely gain additional insight about the reasons to use technology for the purpose of improved student learning.

Collaborating with peers has also been shown to have a positive effect on preservice teachers' technology competencies (Tondeur et al., 2012). As collaboration with peers reduces anxiety and failure avoidance, many studies have strongly suggested using group-based work when designing technology-related curriculum materials (Angeli & Valanides, 2009). Preservice teachers should also learn how to integrate technology into learning through practical application (i.e., by doing). Tearle and Golder (2008) mentioned in their study that many preservice teachers felt that the watching approach had resulted in them lacking experience in actually using specific ICTs deemed relevant to them in their school placements. Thus, it is perceived to be important for preservice teachers to gain authentic firsthand experience of technology integration (Yeh et al., 2014). Also, the whole process of learning of preservice teachers needs to shift away from traditional assessment towards a more continuous form of feedback (Tondeur et al., 2012) as, according to Banas and York (2014), ongoing and process-oriented feedback is considered beneficial to establishing preservice teachers' competencies to use technology in the classroom.

Improving digital competencies of preservice teachers in an integrated and cross-curricular manner is a complex process that requires the application of multiple strategies (Howard et al., 2021; Tondeur et al., 2016). According to Kay (2006), using multiple strategies to teach educational technology usage can result in significant increases in the digital competencies of preservice teachers. However, many studies that focused on the barriers to effective technology usage considered time as an important factor (Ghavifekr et al., 2016; Ottenbreit-Leftwich et al., 2018). Thus, it is assumed that the use of flipped learning as a learning strategy could address the lack of time barrier and thereby enable the use of multiple strategies to be applied in the classroom, and as a result create a more appropriate environment in which preservice teachers may improve their digital competencies.

2.3. Innovativeness and Technology Use

Innovation is simply an idea, practice, or object that is perceived as being new by an individual (Rogers, 2003), and individuals' reactions to innovations are defined as innovativeness (Goldsmith & Foxall, 2003). It has also been defined as a form of willingness for change (Van Braak, 2001) or the trying of new things (Hurt et al., 1977). Rogers (2003) defined innovativeness as the degree to which innovation is adopted early by certain individuals rather than by others in society in general. It is a knowledge-based willingness to change and accept risks whilst moving beyond what is already known (Demirel & Seçkin, 2008). According to the concept of innovativeness being an individual's willingness to accept new ideas, practices, or objects, Rogers (2003) classified individuals according to five categories, as "innovators," "early adopters," "early majority," "late majority," and "laggards."

Innovators represent those 2.5% of society who take risks and exhibit willingness to try out new things, whereas Early Adopters are the 13.5% who adopt an innovation and then lead others in their society to also adopt it. The Early Majority represent just over one-third of society (34%) who will adopt an innovation, but who are unwilling to take risks themselves and who remain cautious about such innovations. The Late Majority also represent 34% of society, and likewise adopt innovations, yet remain skeptical and suspicious toward them, and will happily sit back and wait others in society to first adopt an innovation. The Laggards, on the other hand, are the 16% of society who adopt innovations, but remain prejudiced against innovations and change, and are generally committed to sticking with their existing traditions and routines (Kılıçer, 2011; Rogers, 2003).

Recent studies have shown that innovativeness is an important predictor of the level of teachers' technology usage (Çoklar & Özbek, 2017; Gökçearslan et al., 2017; Tang, 2021). For instance, Lai and Chen (2011) found that innovativeness has a key influence on secondary school teachers' adoption of teaching blogs.

Thus, it may be said that innovative teachers will likely have more willingness to test out the application of new technologies in their classrooms (Jeong & Kim, 2016).

In the literature, studies have been generally focused on determining the innovativeness categories of preservice teachers, and on the relationship between innovativeness and certain variables such as ICT competences, technological pedagogical knowledge, and technology acceptance. These various studies have revealed that the majority of preservice teachers in different teaching programs are in the Early Majority category (Çuhadar et al., 2013; Gökçearslan et al., 2017; Loogma et al., 2012). According to Gökçearslan et al. (2017), having no preservice teachers in the "Innovators" or "Early Adopters" categories is not considered to be satisfactory, considering that teachers tend to be less open to change during the integration of new technologies into the educational environment. In addition, despite there being broad consensus amongst educators, researchers, and practitioners on the importance of innovation, the knowledge of pedagogical approaches and learning tools that could enhance students' innovativeness levels remains limited (Acar & Tuncdogan, 2018). Thus, in the current study, the aim was not to just determine the innovativeness categories of preservice teachers, but also to improve their innovativeness alongside their digital competencies through the practical application of the flipped learning method as a learning approach.

2.4. Purpose of Study

The purpose of this research study was to examine how preservice teachers' experiences in a flipped course affect their digital competencies related to educational technology and innovativeness. The following research questions guided the study:

1. What were the preservice teachers' digital competencies before the flipped course?
2. How do the preservice teachers' experiences in the flipped course affect their digital competencies related to educational technology?
3. What were the individual innovativeness levels of preservice teachers before and after the flipped course?
4. How do the preservice teachers' experiences in the flipped course affect their innovativeness?

3. Methodology

3.1. Research Model/Design

The study utilizes a mixed-methods sequential explanatory design in order to understand how the flipped "Special Teaching Methods" course affected the participant preservice teachers' digital competencies, and individual innovativeness. The design consisted of two distinct phases: quantitative followed by qualitative (Creswell, 2011). The quantitative phase involved a single sample pretest-posttest design, whilst the qualitative phase consisted of a case study.

3.2. Participants

The study was conducted within a four-year Computer and Instructional Technology Education program at a state university in Turkey. 58 students participated in the current study. Each participant was in their third year of study and took the Special Teaching Methods I course as a mandatory curriculum requirement. The course lasted for a total of 10 weeks, with one session of four hours duration held each week. The course was divided into two groups due to the high number of students and the limited 40 computer capacity of the computer laboratory. The course was taught to all the participants using the same laboratory, and was led by the same instructor, who was also a researcher in the current study.

Overall, 39 of the study's participants were male, whilst 19 were female, with their ages ranging from 19 to 21 years old, and all were enrolled as undergraduate students. The participants had each previously taken

courses such as "Basic Information Technologies" and "Instructional Design" during their first grade and second grade. The common learning outcomes from these courses were the integrating of current ICTs into the learning-teaching process, the effective use of teaching methods, techniques, equipment, and materials as appropriate to the subject-matter being taught, and the organization of activities appropriate for the subject-matter teaching with the highest level of contribution to the program outcomes (Anadolu University, 2021). Thus, it was considered that the students each had an adequate background in both technology usage and learning. None of the participants had previously knowledge of the flipped learning approach prior to joining the current study. Each of the participants owned a smartphone and a computer, or just a smartphone, through which they were able to gain access to the Internet.

In the qualitative phase of the study, in order to select which of the participant preservice teachers would attend the semi-structured interviews, their final grades were used as a selection criterion. In total, 15 participant preservice teachers who had achieved the letter grade of AB or above, plus five who achieved a letter grade of DD or below were selected for the semi-structured interviews. The actual names of the participants were each replaced with pseudonyms during the reporting of the findings in order to protect the participants' anonymity.

3.3. Description of the Flipped Instruction

Before class. Each week, the preservice teachers were expected to watch the prescribed prerecorded videos and also to participate within online discussions held on the Canvas LMS. The prerecorded videos for the first 4 weeks of the course were uploaded directly to the Canvas LMS. For the other weeks of the course, the prerecorded videos were embedded into the Canvas LMS from sources such as Edpuzzle and Oppia so as to provide a certain level of interactivity for the course participants. Rather than relying upon only watching prerecorded videos, it was anticipated that carrying out online discussions would help the preservice teachers to determine any missing elements of the course contents, and thereby help to deepen their understanding of the topic being taught.

During class. Each week, different teaching and learning techniques were employed so as to help the preservice teachers to develop their competencies and innovativeness in educational settings. For instance, first week, students were informed about flipped learning strategy and a brainstorm activity designed to reveal pros and cons of flipped learning. In 2nd week, a collaborative activity on designing 21st century education system via infographics established. In 3rd and 4th week, preservice teachers required to investigate different Web 2.0 tools on https://www.egitimcantasi.com/ (an informative educational technology website) and develop an educational material with a Web 2.0 tool that they choose individually. In 7th week, how to use mobile technologies and emerging approaches such as Bring Your Own Device (BYOD) were discussed. In 8th week, preservice teachers gained experiences regarding virtual and augmented reality, and developed a simple augmented reality material for educational purposes. In 10th week, they created their own self-assessment and evaluation materials with emerging technologies.

After class. Following each class, the participant preservice teachers each submitted a reflective report via the Canvas LMS. These reports addressed their learning experiences for that week of the course.

3.4. Data Collection Tools

This mixed-method study was carried out over a period of 10 weeks in the first academic semester (2016/2017). Before and after the implementation, Educational Technology Standards Self-Efficacy Scale (ETSSS) and The Individual Innovativeness Scale (IIS), were distributed to measure the change in preservice teachers. In addition, after the implementation, semi-structured interviews were conducted both to explore the change in preservice teachers and to reveal the reasons of this change.

In order to reveal the participant preservice teachers' digital competences, ETSSS, which was developed by Simsek and Yazar (2016), was employed. The scale is a 40-item, five-point, Likert-type, self-report inventory scale which was used to analyze the participant preservice teachers' competencies in five

dimensions. These dimensions being: (1) facilitating and inspiring student learning and creativity; (2) designing and developing digital age learning experiences and assessments; (3) modeling digital age work and learning; (4) promoting and modeling digital citizenship and responsibility; and (5) engaging in professional growth and leadership. These dimensions were developed based on the ISTE Standards for Teachers (ISTE, n.d.). The Cronbach alpha of the scale was found to be .95 in total, and between .76 and .87 for each of the subscales.

The IIS, which was developed by Hurt et al. (1977) and later adapted to the Turkish context by Kılıçer and Odabaşı (2010), was used in order to reveal the participant preservice teachers' level of innovativeness. The scale consists of 20 items with four factors. The participants were classified according to their total innovativeness scores; in order to calculate the innovativeness score, the total score of the negative items (consisting of eight items) is subtracted from the total score of the positive items (consisting of 12 items) and 42 points added to obtained score. A minimum of 14 and a maximum of 94 points can be obtained from the scale. Those scoring above 80 points are categorized as Innovators, from 69 to 80 as Early Adopters, from 57 to 68 as Early Majority, from 46 to 56 as Late Majority, and below 46 as Laggards. Thus, it may be said that individuals scoring 69 or above can be considered to be highly innovative, but those scoring 69 or below as slightly innovative. The internal consistency coefficient of the scale was found to be .87.

In the qualitative phase of the current study, a semi-structured form was developed by the researchers. In order to ensure the validity and reliability of the forms, two professors and one associate professor from the field of educational technology and one associate professor specialized in qualitative research methods were consulted, and the form revised according to their feedback. The semi-structured interviews lasted between 9 and 31 minutes, during which the following four questions were discussed with the preservice teachers; 1) "How did you feel when you heard that the course would be taught using flipped learning?", 2) "Did you get used to the course with flipped learning as the course progressed?", 3) "How would you evaluate the adequacy of the course activities; both in-class and outside of class?", and 4) "How would you evaluate the flipped course in terms of your individual and professional development?"

3.5. Data Analysis

For the purpose of the current study, the data obtained from the two aforementioned scales were examined for reliability and the Cronbach's alpha internal consistency coefficient was found to be .83 for the IIS, and .85 for the ETSSS. Microsoft Excel and Jamovi 1.1 Software were utilized for the analysis of the quantitative data. In order to answer the question of what the preservice teachers' innovativeness categories were before and after the treatment, Microsoft Excel was used to compute the total innovativeness scores as a means to revealing the preservice teachers' category of innovativeness.

Descriptive statistics were used to present the data gathered from the scales and to respond to the study's research questions: "What were the preservice teachers' digital competencies before the flipped course?", and "What were the individual innovativeness levels of the preservice teachers prior to and following the flipped course?" In addition, in order to reveal whether or not the change in digital competencies and individual innovativeness of the participant preservice teachers was significant, paired sample t-tests were used to compare the total scores obtained from the pretests and posttests.

In order to analyze qualitative data, first, the interviews were audio recorded, with the students' agreement, and were later transcribed by the researcher. Thematic analysis, which is a method used for identifying, analyzing, and reporting themes within data (Braun & Clarke, 2006), was conducted both to explore any changes in the preservice teachers, and to reveal the reasons behind the change. The qualitative data analysis software program, MAXQDA 2020, was used in the analysis of the data. The six phases of thematic analysis employed were familiarization with the data, initial coding, searching for themes, reviewing themes (three educational technology experts plus one qualitative research methods expert reviewed the themes to ensure their validity and reliability), defining and naming themes, and producing the report helped to reveal the reasons for changes identified in the quantitative results.

4. Findings

4.1. Quantitative Findings

4.1.1. Digital competencies of preservice teachers

Prior to conducting the analysis, three outliers were removed from the data set and the assumption of normally distributed score differentials were examined. The assumption was considered satisfied, as the skewness and kurtosis levels were estimated at 0.279 and 0.137, respectively, which is between the maximum allowable values for a t-test (i.e., skew < +/- 2.0 and kurtosis < +/- 2.0; George & Mallery, 2016).

Descriptive statistics and t-test were computed in order to reveal the participant preservice teachers' digital competencies prior to and following the flipped course (FC). The results are presented in Table 1.

Table 1.

Descriptive statistics and t-test results for digital competencies

Competency	Test	n	M	SD	t	p
a) Facilitating and inspiring student learning and creativity	Pretest	55	4.21	.407	-3.898	.000
	Posttest	55	4.45	.494		
b) Designing and developing digital age learning experiences and assessments	Pretest	55	3.78	.647	-5.885	.000
	Posttest	55	4.26	.579		
c) Modeling digital age work and learning	Pretest	55	3.90	.693	-4.269	.000
	Posttest	55	4.25	.594		
d) Promoting and modeling digital citizenship and responsibility	Pretest	55	3.55	.566	-5.068	.000
	Posttest	55	3.99	.559		
e) Engaging in professional growth and leadership	Pretest	55	3.92	.603	-5.476	.000
	Posttest	55	4.29	.559		
Total	Pretest	55	3.88	.492	-6.250	.000
	Posttest	55	4.26	.496		

*p<.05

The results showed that the preservice teachers' mean scores increased in each digital competency dimension, as well as in their total scores. The "designing and developing digital age learning experiences and assessments" was the most improved competence dimension. To gain greater insight on this improvement, certain items with the highest score differential were further examined. For example, the preservice teachers' mean scores on "I can develop technology-enriched learning environments that enable all students to actively pursue their individual development" showed the highest score differential (Mpretest = 3,418; Mposttest = 4,109). Another example was "I can use technology while using alternative assessment methods during the learning/teaching process" (Mpretest = 3,873; Mposttest = 4,418).

The participant preservice teachers also improved their digital competency in the "promoting and modeling digital citizenship and responsibility" dimension. For example, some of the highest improvements were for the "I know the legal responsibilities related to ICT" (Mpretest = 3,418; Mposttest = 4,055) and "I am sensitive about copyright when using digital sources" (Mpretest = 3,182; Mposttest = 3,800) items. Although this improvement remained lower according to other dimensions, the "promoting and modeling digital citizenship and responsibility" dimension saw the second-highest improvement overall.

Paired sample t-test was performed in order to test whether or not these improvements had statistical significance. The analysis indicated that, the mean score of the posttest (M = 4.26) was significantly greater at the $p < .05$ level (note: $t(54) = 6.250$, $p = .000$) than the mean score of the pretest (M = 3.88). These findings revealed that the participant preservice teachers' digital competencies significantly improved over the duration of the FC.

4.1.2. Innovativeness of Preservice Teachers

Descriptive statistics were computed for the purpose of revealing the innovativeness categories of the participant preservice teachers, both prior to and following the FC. The innovativeness categories prior to the FC are presented as shown in Figure 1.

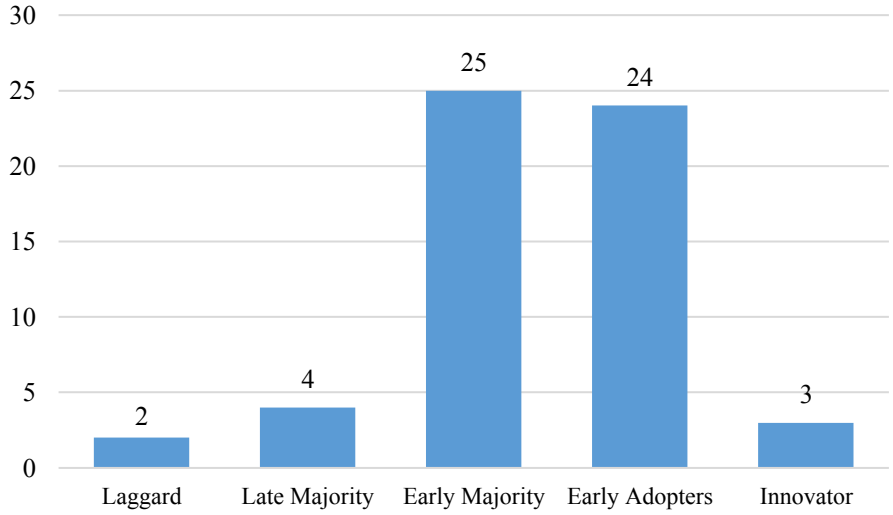

Fig. 1. Innovativeness categories of preservice teachers prior to FC

Before the FC, the majority of the participant preservice teachers were either Early Majority (43.10%) or Early Adopters (41.37%). These findings indicate that 43.10% of the participant preservice teachers spent the majority of their time thinking about innovativeness rather than accepting it. By contrast, 41.37% of the preservice teachers tended to take risks whilst accepting a new idea or innovation, and also lead other groups towards eliminating the risks of accepting new ideas or innovations.

Following the FC, the innovativeness categories of the participant preservice teachers differed from those recorded prior to the FC. These post-FC categories are presented as shown in Figure 2.

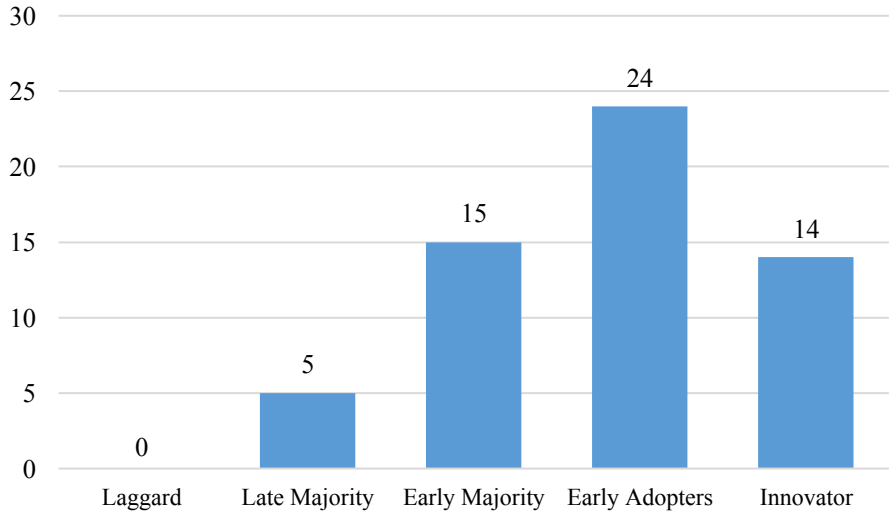

Fig. 2. Innovativeness categories of preservice teachers following the FC

Figure 2 illustrates that the distribution of innovativeness categories of the participant preservice teachers moved more towards that of the Innovator. Unlike the innovativeness categories recorded prior to the FC, the number of preservice teachers in the Innovator category increased, whilst the number of preservice teachers in Early Majority category were shown to have decreased. Most of the preservice teachers were reportedly in the category of Early Adopters (41.37%).

To test whether or not the change in innovativeness categories of the preservice teachers was statistically significant, paired sample t-test was performed based on their innovativeness scores. Prior to conducting the analysis, three outliers were removed from the data set and the assumption of normally distributed difference scores was examined. The assumption was considered to be satisfied, as the skewness and kurtosis levels were estimated at -0.12 and 1.895, respectively, which is between the maximum allowable values for a t-test (i.e., skew < +/- 2.0 and kurtosis < +/- 2.0; George & Mallery, 2016). The analysis indicated that the mean score of the posttest (M = 71.47) was significantly greater at the $p < .05$ level (note: $t(57) = 3.287$, $p = .002$) than the mean score of the pretest (M = 67.69).

4.2. Qualitative Findings

The findings of the semi-structured interviews conducted with 20 preservice teachers at the end of the FC are presented in Table 2. Two themes emerged from the analyses conducted to determine precisely which aspects of preservice teachers' digital competencies and innovativeness levels have changed. These are "professional development" and "personal development."

Table 2.

Preservice teachers' digital competencies and innovativeness

Theme	Code	*n*
Professional Development	Using Web 2.0 Tools for Teaching	12
	Acceptance of Flipped Learning	11
	Transfer of Learning	6
	Learning Effective Teaching	5
	Increase in Self-Efficacy Belief	4
Individual Development	Doing Research	13
	Gaining Different Perspectives	7
	Learning How to Learn	3
	Following Innovations	2
	Cooperating with peers	1

4.2.1. Professional development of preservice teachers

The "using Web 2.0 tools for teaching" (n = 12), as a code under the Professional Development theme, is notable. The participant preservice teachers reported that their awareness of Web 2.0 tools had increased by the end of the course, and that they expressed a wish to actively incorporate such tools into their future classes. Stating that having been previously familiar with a limited number of Web 2.0 tools, Beste underlined having an expanded awareness of various Web 2.0 tools by adding:

> You know, there are like ten different Web 2.0 tools we use as students. In that regard, I believe it [the course] has really helped us to expand our knowledge. (Beste)

Moreover, Web 2.0 tools were considered among the most beneficial of the content areas covered in the course in terms of the participant preserve teachers' professional development. Özgür's, another of the participant's preservice teacher, stated that "*We didn't know any of them, we'd never heard of or used them before. We didn't know how they worked*" which demonstrates how little familiarity some of the preservice teachers had with Web 2.0 tools at the beginning of the course. Yasin, whose academic grade was considered to be lower than average at the end of the course, evaluated the effectiveness of Web 2.0 tools for measurement and evaluation purposes as follows: "*Tools like Kahoot and Socrative used for measurement and evaluation were effective, they were good tools*." Additionally, learning about the Web 2.0 tools aided not only the establishment of technology-supported learning environments, but also in the

enhancement of the preservice teachers' levels of innovativeness. Salih, another of the participants, expressed having swiftly adopted the new Web 2.0 tools following the flipped classroom lessons as follows:

> When I prepare a presentation, for example, I now immediately incorporate Web 2.0 tools. I use all of them. It helps when I have to teach a lesson or I am going somewhere; I say, 'I know something like this, let's use it.' (Salih)

As implied by the preservice teacher's statement, it is clear that they not only adopted the tools, but also encouraged their usage within a variety of settings. In this respect, it may be stated that Web 2.0 tools can positively contribute to the innovativeness levels of preservice teachers, as well as to their digital competencies.

Another noteworthy code category within the Professional Development theme category is "Acceptance of Flipped Learning" (n = 11). Although the preservice teachers stated that they first struggled due to a lack of familiarity with the flipped learning (FL) approach, they reportedly adopted it in subsequent processes and expressed a desire to utilize it themselves once they become qualified serving teachers. Elif shared some thoughts regarding the experiences of the first weeks, stating that, "*The first weeks challenged us, including the entire class. Because we had never previously seen or experienced anything quite like this.*" As the weeks passed, the preservice teachers became more accustomed to FL and were able to adopt the new approach. This adoption process was expressed strongly by some of the participant preservice teachers, for example:

> The other classes are extremely boring in comparison to this (FL). After a given amount of time, classes taught using direct instruction can become extremely tedious. (Taner)

> I began seeking to adopt this (FL) in other classes too. I wish that all classes could be like this one (FL). (Elif)

The preservice teachers' adoption of FL and their enjoyment of the course subsequently motivated them to incorporate the FL model into their own future classes once they qualified as teachers. Two of the preservice teachers who received relatively low-grade point averages in the FL-taught course expressed a desire to also use the FL model in their future classes despite their own personal lack of success, having expressed that: "*I want to use this flipped classroom model in my future classes because I want my students to arrive already prepared for the lesson* (Gökhan).

> I will become a teacher in the future, and I don't want my students to dislike the lesson just because of me or the way I taught it. Thus, it would be nice to utilize different models such as this. (Okan)

Ali, on the other hand, thought that FL could be used in order to make verbal lessons more enjoyable:

> If there is a verbal lesson, I could make it more enjoyable with flipped classroom practices or the use of a Web 2.0 tool. (Ali)

Remzi also emphasized that FL may help students develop greater appreciation for their teacher and stated the intention to use it when teaching:

> If I become a teacher, I will use the Flipped Classroom model. I can work closer with my students. I even believe that it is a model that can increase students' appreciation for their teachers. (Remzi)

The adoption of FL and the preservice teachers' experience not only benefited them professionally, but also helped them to realize that lessons could be taught in different ways. Seval explained this as follows:

> Presenting videos in my own voice and in the way others have done previously, rather than teaching the lesson somehow. (Seval)

It may be stated that the preservice teachers gained new perspectives which had a positive effect on their innovativeness. Under the Professional Development theme, the code that showed positive development of both the preservice teachers' digital competencies and their innovativeness was "transfer of learning" (n = 6), with opinions found regarding incorporating information acquired during lessons into other environments. Sena, for example, expressed satisfaction at having benefited from information acquired from presentations made in other classes, and stated:

> I believe it has made a significant contribution in terms of my teaching profession. This is also something I use in my other lessons. (Sena)

Similarly, some of the other preservice teachers stated that they used or wanted to use the information acquired during the lesson in other environments. Özgür said, "*Let me give you an example. In some lessons, I taught the lesson through infographics instead of PowerPoint or Prezi. I only made the infographic,*" whilst Remzi mentioned, "*When I first saw it, I was shocked to know such a thing even existed. In fact, I will use augmented reality in a project this next semester.*"

As implied in the statements, whilst the preservice teachers improved their digital competencies, they also employed them within different environments. In this way, they also ensured sharing their newly gained knowledge. Other codes under the Professional Development theme were "learning effective teaching" and an "increase in self-efficacy beliefs."

On "learning effective teaching," Öznur stated having learned how to make a class less boring:

> I learned how I could teach a lesson in a more enjoyable way. This is very important because if it were someone else, even they would teach direct instructional method; the lesson would be really boring. (Öznur)

On the other hand, Hülya stated having learned how to plan lessons in line with developing technologies:

> I mean, I learned how to plan a lesson thanks to you. Now, I can upload a video beforehand because the technology allows me to do so. People can access technology from everywhere now. These are the exact reasons why I want to incorporate them into my classroom. (Hülya)

At the end of the flipped classroom treatment, some of the participant preservice teachers stated having experienced an increase in self-efficacy. Ülkü stated that if they had been taught according to the traditional classroom method instead of flipped learning, it would not have been sufficient and that they had been positively affected by their FL experience:

> We already learned about the Web 2.0 tools before the class by watching the relevant videos and undertaking relevant activities. Then, in the actual class, doing the relevant exercises makes you become more interested in a subject, and you start to realize that you can do what is required. (Ülkü)

Neslihan, on the other hand, expressed feelings regarding self-belief in the capability to profess in teaching:

> I used to think; 'I am going to be a teacher, alright, but what am I going to teach? I mean, Am I just going to lecture?' But after learning about all those programs, you know, I believe I could really do something. It really makes me feel good about myself. (Neslihan)

It may therefore be stated that the activity-based learning provided by FL helps preservice teachers to gain experience and, therefore, to increase their self-efficacy beliefs.

4.2.1. Professional development of preservice teachers

The other theme that emerged from the semi-structured interviews held with some of the participant preservice teachers regarding their digital competencies and innovativeness levels is their Personal Development. Under this theme, the most notable code was "doing research." The preservice teachers stated that they made the most progress in conducting research following the end of the flipped classroom practices. Some of the preservice teachers' views regarding this are as follows:

> I think that what this activity taught me the most was doing research and searching for the right results, that is, conducting research correctly. (Temel)

> I was doing research. I was searching for the data and viewing some of the studies on the Internet, and I've been reading some articles. (Özgür)

Another code was "gaining different perspectives," whereby preservice teachers reported changing and improving their perspectives. Accordingly, Beste mentioned experiencing an awareness as follows:

> If I were to assess it from both my own and a teacher's perspective, I realized that I could teach with various models. Whether with flipped classrooms or a different model, I realized that education could be achieved through activities, even if we don't teach the lesson in the standard way. (Beste)

While the preservice teacher was referring to an activity in the classroom process in the previous statement, Hülya also expressed the contribution of discussions held outside of the class:

> I witnessed different perspectives because I was also reading my friends' comments. As I mentioned earlier, I have done a lot of research. I joined in discussions, learned many things, and I noted them down. That is how they made a significant contribution to me. (Hülya)

Other codes under the Personal Development theme were "learning how to learn," "following innovations," and "cooperating with peers." Under "learning how to learn," Neslihan stated having improved in online learning:

> Even when we look at Coursera rates, we see that not many people participate. In terms of learning how to learn, I can truly observe my own improvement. I can study better now. (Neslihan)

Under "following innovations," Taner mentioned following methods such as FL:

> From my own point of view, it helps me to consider different aspects. I enjoy attending the class. The method should become more advanced by the time I start my profession. I intend to follow these advancements and incorporate them in my class. (Taner)

Under "cooperating with peers," Öznur stated how the contribution of group works:

> First, we mostly worked as a group in most of the activities. Working as a group contributed a lot to us. I learned how to work with people who you do not necessarily agree with or who may think differently than you. (Öznur)

5. Conclusion and Discussion

5.1. Development of preservice teachers' digital competencies

The current study concluded that preservice teachers' digital competencies improved both throughout and in all sub-dimensions of the Educational Technology Standards Self-Efficacy Scale at the end of the FC (see Table 2). Qualitative findings shed light on the factors that contributed to this development. According to the findings gathered under the Professional Development theme, "using Web 2.0 tools for teaching,"

"acceptance of flipped learning," "transfer of learning," "learning effective teaching," and "increase in self-efficacy belief" all played an important role in the development of the preservice teachers' digital competencies (see Table 3).

FL played a critical part in this development too. As stated in the literature, FL's elimination of the time constraint (Akçayır & Akçayır, 2018) enables preservice teachers, as seen in the current study, to develop their digital skills through various activities based on different approaches. The preservice teachers in this study actively participated in the activities organized in the remaining classroom time, and as such, the opinion found in the literature that preservice teachers should gain firsthand experience in transferring technology to learning environments (Yeh et al., 2014) was successfully completed. Previous studies found that there is a positive relation between the number and diversity of tools used, and the level of digital competence (Ghomi & Redecker, 2019; Hatlevik, 2017; Tondeur et al., 2018). In this flipped course, the preservice teachers became familiar with many different Web 2.0 tools, gained knowledge on new technological concepts, and created and presented products each week either individually or in groups. This active process enabled the preservice teachers to progress mostly in the dimension of "designing and developing digital age learning experiences and assessments." In the qualitative findings of the study, "using Web 2.0 tools for teaching" and "learning effective teaching" supported this notable progression.

The way that the course in the current study was designed according to FL may be considered as a model that preservice teachers could utilize in their future teaching careers. Preservice teachers reported that they gained new knowledge about course design and that they could enrich them by using Web 2.0 tools. The stated opinions corroborate the literature's views on the importance of preservice teachers having a role model educator from whom they can learn and emulate (Figg & Jamini, 2011; Howard et al., 2021; Lu & Lei, 2012) and on technology being taught through integration with content and pedagogy (Graziano, 2017).

Additionally, it was found that the evaluation of FL as an effective pedagogical approach in the eyes of preservice teachers strengthened their belief that when they themselves become qualified teachers, they would be able to conduct various activities, improve teacher-student communication, and make their lessons more enjoyable for their students. The various views of the participant preservice teachers were as "learning effective teaching" and "increase in self-efficacy belief." This finding supports previous studies of Li et al. (2019) and Tondeur et al. (2018) that shows pedagogical beliefs, their self-efficacy or their attitudes can be associated with their uptake of educational technology use.

5.2. Development of preservice teachers' personal innovativeness levels

Studies on innovation in the literature indicate that preservice teachers are generally in the early majority category (Adigüzel, 2012; Çuhadar et al., 2013; Erdoğan & Güneş, 2013; Kert & Tekdal, 2012; Korucu & Olpak, 2015; Mazman Akar, 2019; Özgür, 2013; Suer & Kinay, 2019; Yorulmaz et al., 2017). In the research conducted in the current study, it was determined that the innovativeness categories of the preservice teachers were similar to that reported in the literature prior to the application. Following the application, while the innovativeness categories of the preservice teachers ranged from early adopters to innovators a significant increase in the analysis results was also determined. This result indicates that the personal innovativeness of preservice teachers can be improved. The qualitative findings obtained provide an insight into the reasons for the change in the innovativeness of preservice teachers. Accordingly, the fact that the participant teachers were taking a course with a different teaching and learning approach for the first time had a profound effect on them. They expressed this effect under the code of "Acceptance of Flipped Learning" under the Professional Development theme. This situation corroborates the view stated in the literature that innovative pedagogical practices should be supported on technology-based platforms (Avidov-Ungar & Forkosh-Baruch, 2018). FL is an innovative pedagogical approach for preservice teachers, and the entire course process was supported on technology-based platforms in the current study's experiment. The fact that the participant preservice teachers adopted the FL process is significant in terms

of their innovativeness level, as innovativeness is also defined as the degree to which innovations are adopted (Özgür, 2013).

However, what is perhaps innovative for preservice teachers is not only the pedagogical approach employed, but also the content themes that are chosen. Web 2.0 tools, mobile learning, virtual and augmented reality, and also gamification are all themes that the participant preservice teachers previously lacked having sufficient knowledge of. Their familiarity with different Web 2.0 tools enabled them to then adopt other Web 2.0 tools more quickly. In addition, the fact that the preservice teachers gained firsthand experience in the subjects they were taught enabled them to then apply their knowledge within different settings. This situation was also presented within the qualitative findings of the study as the "transfer of learning," which was reported under the Professional Development theme. The fact that the preservice teachers applied their newly acquired knowledge in various situations and thereby helped to disseminate an innovation is another indicator of their innovativeness level having developed.

Another factor that contributes to the innovativeness of preservice teachers when it comes to the selected content themes is that they attend class sufficiently prepared. In the current study, this approach enabled the participant preservice teachers to perform research in order to broaden their knowledge of the subject in hand, and they reportedly developed new perspectives from their research. According to Othman (2016), one of the innovative personality characteristics of teachers is openness. Openness is the state of having an open mind to accept and adapt to change (LePine et al., 2000). The fact that the participant preservice teachers developed perspectives both through the selected content themes and through undertaking research led them to have a more open mind. Given that teachers' adoption of technology is influenced by their personal innovators (Mazman Akar, 2019), having diverse perspectives, conducting research, and following those who are considered innovators are important in terms of the development of their level of innovativeness.

6. Limitations And Suggestions

Numerous theoretical frameworks have been developed in the literature to define digital competencies. The current study is grounded on the National Educational Technology Standards developed by the ISTE in 2008 for teachers. Therefore, it is recommended to conduct any future studies based on the development of digital competencies based on the current standards that were subsequently updated in 2016.

In the current study, the sample group was comprised of third-year undergraduate students from the Department of Computer Education and Instructional Technology. These students are assumed to possess fundamental digital skills and are therefore considered to be more open to innovation than students enroled to other teaching programs. Therefore, further research on the development of digital skills and innovation levels with more diverse sample groups is considered necessary.

In the current case, a single group study was conducted as the study's primary focus was on the development of preservice teachers' digital competencies and innovativeness. While FL was determined to be effective in improving both the digital competence and innovation levels of the participants, the fact that a comparison with the traditional method was not made in this process may be considered as a limitation of the current research. Therefore, it is recommended that future studies examine the effect of FL by also comparing it with different learning approaches.

Both quantitative and qualitative results show that flipped learning has important potential to develop digital competence and innovativeness of preservice teachers. Thus, it is recommended for teacher educators to design active learning environments according to multiple strategies that enable preservice teachers to enrich their experiences in line with technological and pedagogical developments.

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