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Using Cooperative Learning and the Flipped Classroom Model with Prospective Teachers To Increase Digital Literacy Self-Efficacy, Technopedagogical Education, and 21st-Century Skills Competence

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Abstract

The aim of this study was to investigate the effect of cooperative learning on the digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perceptions of prospective teachers based on the flipped classroom model. The research used an experimental pattern with pretest-posttest and a control group, which is one of the semi-experimental models. The participants were 68 prospective science teachers studying at the 2nd and 3rd grades at a public university in the 2019–2020 academic year. Three scales were used to develop the data collection tool for the study: a Digital Literacy Self-Efficacy Scale; a Technopedagogical Education Competence Scale, and a 21st-Century Skills Competence Perception Scale. The results showed that a cooperative learning model and a flipped classroom model were both significantly effective in developing the pre-service teachers' skills. However, this study showed that cooperative learning used in conjunction with the flipped classroom model was more effective than the cooperative learning model used alone. It is recommended that technology-based student-centered models be used in teacher training programs.

Keywords: Cooperative/Collaborative Learning; Distance Education and Online Learning; Improving Classroom Teaching; Teaching/Learning Strategies; 21st Century Abilities.

DOI: 10.29329/ijpe.2022.439.9

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INTRODUCTION

In the 21st-century, students are creative and open to innovation. They are skilled in communication and collaboration, and they are open to research, problem-solving, and critical thinking. Because they are expected to meet very high standards (Koenig, 2011; Lai & Viering, 2012), such skills should be developed at all educational levels from pre-school to higher education. To develop these skills in the teaching-learning environment, student-centered models should be used, and many student-centered learning and teaching models have been developed. One of these models is the flipped classroom model, and another is the cooperative learning model.

Discussing the flipped classroom model, Bishop and Verleger (2013) emphasized that it is a teaching-learning model that lets students perform activities and find solutions to problems through individual or group activities, with the support of the teacher. Demiralay and Karatas (2014) described the flipped classroom model as a "blended learning model," in which the information that has usually been presented by the teacher in traditional teaching models is transferred to an online platform, and the tasks that had been done outside the classroom are brought into the classroom. The flipped classroom model has many positive aspects. It enables more effective use of time in the classroom. It allows students to learn at their own pace. It increases the interaction between the students and the teacher. It places the responsibility for learning on the student in the hope of increasing the academic achievement, motivation, and interest of the students (Aslan, 2021a; Aslan, 2021b; Aycicek, 2019; Say & Yildirim, 2020; Webb & Doman, 2020; Yang & Chen, 2020). However, there are limitations to this model such as students' lack of interest in the lesson, the need for students to have internet access, and teachers' inability to integrate the required technology in a qualified way (Debbag, 2019; Springen, 2013). When lessons are taught in the traditional method, there is an average of 25 minutes of lecture and subsequent activities. This is seen as a weakness of this method because if students are not ready to learn when they come to class, time is lost for learning the subject (Bergmann & Sams, 2012). In the flipped classroom model, knowledge, skills, and behaviors at the level of knowledge and comprehension are gained outside of school, while additional knowledge, skills, and behaviors are gained through classroom activities under the direction of the teacher. In that way, classroom time is used more effectively, and students are more active and engaged in the classroom. This helps to ensure the permanence of learning (Chilingaryan & Zvereva, 2017). Moreover, this model offers the opportunity for the teacher to give one-on-one attention to students in the classroom. In this model, the teacher is in a position to guide the process (Bergmann & Sams, 2012).

The cooperative learning model can be defined as the instructional use of small groups, enabling students to work together to maximize their own learning and that of the other students (Johnson et al., 1994, p. 3). According to Slavin (2015), in the cooperative learning model students work together in small groups, and each group member is responsible for the learning of the other group members, and they rewarded according to the evaluation results of the groups, at least if their learning level allows this. There are many benefits of using the cooperative learning model in the learning-teaching environment. these include developing higher-order thinking skills and communication skills, ensuring that the learner takes responsibility for learning, ensuring active participation in the course, increasing students' leadership skills, and increasing their academic success (Bayrakceken et al., 2015). When all these benefits are considered, it will be very beneficial to use learning models that complement the flipped classroom model, which is a student-centered approach, in all educational levels from pre-school education to higher education.

Undergraduate programs, which are often the last stage of formal education, are of great importance if society is to raise individuals with the skills required in today's world (Günüç et al., 2013). In this regard, modern learning-teaching models that center the student in higher education institutions can be considered as an extremely important topic. This is especially true in teacher training institutions. Modern, student-centered, technology-based teaching-learning models must be used because they ensure that prospective teachers can grow up as individuals who work collaboratively, have creative and critical thinking skills, develop communication skills, solve problems, and use technology effectively. As a result, they can transfer these skills to future generations more easily. The application of models based on modern teaching-learning approaches that activate the student in the process of teacher training programs may also affect the pre-service teachers' digital literacy self-efficacy, technopedagogical education competencies, and 21st-century skills competence perceptions.

Digital literacy is the ability to access, produce, and share the right information and use technology in learning-teaching processes, using different technologies correctly (Hamutoglu et al., 2017). A digitally literate individual is an individual who is creative, innovative, able to cooperate, communicate, think critically, solve problems, use decision-making skills, understand technological concepts, and use technology in ways that make them digital citizens (Ocak & Karakus, 2018a). It is expected that teachers are digitally literate and their self-efficacy is high. We live in the digital age so teachers should be able to use digital tools. In this respect, the digital literacy competencies of prospective teachers should be improved in undergraduate education.

Technological pedagogical content knowledge (TPACK) is information that goes beyond the three "core" components (content, pedagogy, and technology). Technology is an understanding that emerges from the interactions between pedagogy and field knowledge (Koehler & Mishra, 2009, p. 66). The TPACK model has seven structures: technology knowledge (TK), pedagogy knowledge (PK), area knowledge (AK), pedagogy area knowledge (PAK), technology area knowledge (TAK), technology pedagogy knowledge (TPK), and technological pedagogical content knowledge (TPACK) (Mishra & Koehler, 2006). Technopedagogical education competence is the ability to apply the components of technological pedagogical content knowledge effectively in the teaching-learning environment. Today, using technology effectively in the teaching-learning environment is increasingly important. In this regard, prospective teachers' having technopedagogical competence can use their skills to organize the learning-teaching environment effectively.

There are skills that individuals should use in the twenty-first century and that should be gained by individuals through education. They include creativity and innovation, communication and collaboration, research and information fluency, critical thinking, problem-solving and decision making, digital citizenship, and technology processes and concepts (ISTE, 2007). Teachers have an important role in imparting twenty-first-century skills to individuals. Teachers must organize their teaching-learning environments taking into account twenty-first-century skills so their students can be trained to meet the requirements of the age. Therefore, it has become important to improve the perceptions of prospective teachers for 21st-century skills in undergraduate education. Prospective teachers will use these skills more effectively when they teach if they have acquired 21st-century skills in undergraduate education. Therefore, student-centered teaching-learning models that develop these skills in the teaching-learning environment should be used in teacher training programs.

An examination of the scholarly literature in Turkey compared the flipped classroom model of prospective teachers to attitudes towards geometry (Ozdemir, 2019), academic achievement and motivation to learn (Duman, 2019), self-efficacy, and attitudes toward lessons (Debbag, 2019). Further reading identified studies of the effects of writing skills, self-regulation skills in learning, and their interactions in the classroom (Aydemir, 2019). Likewise, the cooperative learning model promoted academic achievement and attitudes towards learning (Arslan, 2016), acceptance, sharing, and learning performances (Hamutoglu, 2018), social skills (Sarsar, 2008), epistemological beliefs (Iyi, 2018), and problem-solving. There were studies of the effect of these skills (Budancamanak, 2017). A search for literature in Turkey about class models to train prospective teachers in digital literacy self-efficacy, teknopedagojik educational qualification, and the impact of the qualification for twenty-first-century skills did not reveal any studies. This clearly shows that there is a gap in the literature. In addition, the studies that examined learning models like the flipped classroom model only compared such approaches to traditional methods. There were no studies that compared two student-centered models with each other. This indicates reveals the importance of this study, and it suggests that this study will contribute significantly to the literature.

Studies have shown that there are many benefits of using technology in education in an integrated manner. Today, it is said that effective technology integration should be done in education. For this, prospective teachers should have knowledge about technology integration. Teacher training programs should also be organized taking into account technology integration. Based on the flipped classroom model, this study attempts to examine digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence with prospective learning. The importance of this study is that it is up-to-date and original to organize activities for cooperative learning based on the flipped classroom model and activities to improve digital literacy self-efficacy, technopedagogical education competencies, and 21st-century skills competence perception. This research is considered functional in terms of providing suggestions for the use of the flipped classroom model, which is a new model in education, and it provides clues about the quality of in-class and out-of-class learning activities. In addition, it is considered important in terms of providing suggestions to researchers and practitioners who want to work on the subject.

The aim of this study is to investigate the effect of cooperative learning on digital literacy self-efficacy, technopedagogical education competencies, and 21st-century skills competence perceptions based on the flipped classroom model. Thus, this study has two research questions:

1. Is there a significant difference between the pretest-posttest scores of the experimental group and control group digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perception scales?

2. Is there a significant difference between the posttest scores of the experimental and control groups on the digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perception scales?

METHOD

Model of the Research

This research uses an experimental model to determine the effect of one or more independent variables on the dependent variable in an environment that can be controlled by the researcher (Buyukozturk, 2008; Karasar, 2006). This research used a semi-experimental design. In educational research, it is often not possible for researchers to perform real experimental studies. This is because it is impossible to distribute people impartially to groups in school and classroom settings (Ozmen, 2014, p. 60). Since the classes in which the experimental process was carried out were previously created by the university administration, it was not possible to assign groups impartially. Therefore, a semi-experimental design was preferred in this research. In this research, a pretest-posttest control group design was used. The experimental process was used with the groups after the pretest was given to the experimental and control groups. After the experimental process was over, a posttest was given to those groups (Johnson & Christensen, 2014). Within the scope of the research, the experimental process was applied in the instructional technologies course for prospective teachers studying in the 2^{nd} and 3^{rd} grades in the science education department. The prospective teachers studying in third grades were randomly assigned to the experimental group, while prospective teachers studying in second grades were randomly assigned to the control group. Cooperative learning activities based on the flipped classroom model were used with the experimental group, and activities based on the cooperative learning model were used with the control group. The experimental design of the research is presented in Table 1.

Table 1. Experimental design of the research

Group	Pretest	Experimental process	Processing time	Posttest
Experimental	Digital literacy self-efficacy Technopedagogical education competence 21st-century skills competence perception	Cooperative learning based on the flipped classroom model	14 weeks	Digital literacy self-efficacy Technopedagogical education competence 21st-century skills competence perception
Control		Cooperative learning method		

Study Group

The participants in this study were 68 prospective teachers studying in the 2nd and 3rd grades of the science education department at a public university in the 2019–2020 academic year. Before starting the experimental process, a t-test was used to determine whether there was a significant difference between the overall academic grade averages of the prospective teachers. The results are presented in Table 2.

Table 2. Academic grade averages t-test results

Group	N	$\overline{X}$	sd	t	*p*
Experimental	36	3.02	.42	-.266	.79
Control	32	3.00	.44		
Levene's Test: F=.182, $p>.05$					

Table 2 shows that there was no significant difference in the overall academic grade averages of the prospective teachers in the experimental and control groups ($t=-.266$, $p>.05$). Based on this result, it can be said that the prospective teachers in the experimental and control groups are equivalent in terms of their general academic averages. Moreover, a multivariate analysis of variance (MANOVA) was used to determine whether there was a significant difference between the pretest scores of prospective teachers in the experimental and control groups. The results are presented in Table 3.

Table 3. MANOVA results of pretests of experimental and control groups

Variable	Group	N	$\overline{X}$	SS	sd	F	p	η^2
Digital literacy self-efficacy	Experimental	36	3.28	.75	1-66	3.78	.05	.05
	Control	32	3.61	.64				
Technopedagogical education competence	Experimental	36	3.15	.75	1-66	2.35	.13	.03
	Control	32	3.41	.61				
21st-century skills competence perception	Experimental	36	3.32	.74	1-66	3.63	.06	.05
	Control	32	3.62	.50				

In the MANOVA, digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perception were the dependent variables, and the experiment and control groups were the independent variables. Before MANOVA was executed, the assumptions of normality, univariate and multivariate extreme values, linearity, multiple correlation problem, and homogeneity of variance-covariance matrices were examined, and no serious violations were detected. There was no statistically significant difference between the groups in the context of combined dependent variables ($F_{(1-66)}=1.989$, $p=.12$; Wilks'Lambda=.915; $\eta2=.08$). As seen in Table 3, there was no significant difference between the pretest scores of the experimental and control groups in any measurement ($p>.05$).It is possible to say that the two groups created in this case are equivalent in terms of all measurements.

Experimental Process

The experimental procedures related to the research were completed in 14 weeks. The activities were carried out simultaneously and in parallel in the two groups and were completed as planned. The activities were used with the experimental and control groups in the computer laboratory of the university.

1.Activities used with the experimental group

Within the scope of the research, activities for cooperative learning based on the flipped classroom model were used with the experimental group. Pretests were carried out before applying activities to the experimental group. A flipped classroom model was used with the experimental group through the teaching management system (Blackboard). Therefore, this teaching management system was introduced to the prospective teachers in the experimental group, and its use was explained in a practical way. Then, the researcher prepared and uploaded the content of the instructional technologies course to the teaching management system. These included animation, simulation, presentation tools and digital story preparation, video use in lessons, augmented reality application, game-based measurement-evaluation tools, virtual classroom application, class website preparation, twitter, Facebook, and videos about social media use for educational purposes such as Instagram. In addition, lecture notes, articles, and theses related to these subjects were uploaded to the system. Videos and lecture notes were uploaded to the system before the topics were explained. Thus, prospective teachers related to the subject to be explained that week participated in the course with knowledge. The content and activities of the prepared videos were presented to five faculty members working in the education sciences department and a science teacher. All of them have studied technology integration in education, and their opinions were considered. Because of their feedback, the videos and activities were completed and implemented. The prospective teachers examined the videos and lecture notes individually outside the school, and in the classroom, groups were formed to design activities for the units included in the science curriculum with the subject discussed that week. Groups of six were created to apply the cooperative learning model to the students in the experimental group. While creating the groups, attention was paid to distributing male and female students equally to the groups. In addition, considering the academic success of the prospective teachers, the groups were designed to be equivalent. Each group had a name and its own emoji. The groups were asked to choose a group leader and a secretary. In the classroom, the group leaders asked what the group members learned about the subject of that week, and they enabled all the group members to speak for 3 minutes. The class secretary recorded the information learned by the group members and the ideas they suggested. Then, the groups were asked to prepare an activity for the unit on the subject for that week. For example, an animation of the group for the sixth grade “systems in our body” unit was assigned. Previously, it was uploaded to the teaching management system on how to use animation in education and video and lecture notes about animation programs. Group members were asked to view these videos and read the lecture notes. Under the leadership of the group leader, the groups decided how to make animation by listening to each other’s views for an average of 20 minutes. Meanwhile, attention was paid to the positive dependence among the group members. All group members were encouraged to express their opinions, take responsibility for the duties of the group, and participate actively. In this regard, the researcher provided the necessary guidance and assumed the role of guide to facilitate the work of the groups. Later, the group leaders presented the activities they prepared for the subjects in the classroom. Badges on the teaching management system were given to the group that performed the best activity for that lesson. This created a sense of competition among the groups. After all the subjects were applied in this way, a posttest was given to all the members of the experimental group.

2.Activities used with the control group

Activities used with the control group were based on the cooperative learning model. Pretests were used with the control group before the activities were implemented. Prospective teachers in the control group were divided into groups of five or six. While creating the groups, attention was paid to distributing male and female students equally. In addition, considering the academic success of the group members, the groups were designed to be equivalent. Each group had a name and its own emoji. The groups were asked to choose a group leader and a secretary. The researcher explained the subject of the week and the programs the prospective teachers could use in the classroom. Then the group members came together to prepare activities for the units given to them. The group leaders ensured that each member had 5 minutes to discuss the subject, and the ideas that emerged were written by the group secretary. For example, a digital storytelling of the group for the eighth grade" DNA and genetic code" unit was assigned. Group members came together and exchanged ideas for 20 minutes about how to prepare a digital story for that unit. Meanwhile, it was ensured that there was a positive dependence among the group members, and all group members were encouraged to express their opinions, take responsibility for duties in the group work, and participate actively. In this regard, the researcher provided the necessary guidance and assumed the role of guide to facilitate the work of the group members. Later, the group leaders presented the activities they prepared for the subjects in the classroom. The researcher prepared a sign with photos, names, group names, and emoji's of the group members. Badges were affixed to the sign of the group that performed the best activity that week. This created a sense of competition among the groups. After all the subjects were applied in this way, a posttest was given to all the members of the control group.

Data Collection Tools

This study used four data collection tools.

1. Personal information form: A personal information form was created by taking into account the opinions of experts and other studies in the literature. This form included questions to determine the gender of the participants, their academic achievements, computer status at home, parental education, and the socio-economic status of the family.

2. Digital literacy self-efficacy scale: A digital literacy self-efficacy scale developed by Ocak and Karakus (2018b) was used to prepare the tool for this study. Exploratory and confirmatory factor analyses were used while developing the scale. The scale was developed by applying it to 334 prospective teachers. Using an exploratory factor analysis, the scale was found to comprise 4 factors and 35 items. Factor loadings of the scale varied between .46 and .72.The scale's dimensions explained 53% of the total variance. The reliability coefficient of the scale was .96.The confirmatory factor analysis performed while developing the scale showed that the fit indices were appropriate (Ocak & Karakus, 2018b). In this study, the Cronbach alpha coefficient of the scale was examined and found to be .98. A Cronbach alpha coefficient of.70 and above indicates that a scale is reliable (Fraenkel et al., 2014).

3. Technopedagogical education competence scale: A technopedagogical education competence scale, developed by Kabakci et al. (2012) comprised 4 factors and 33 items. The design factor showed how to integrate those elements with appropriate technology along with planning and developing curriculum in the learning-teaching process. The application factor meant using appropriate technologies to implement the plans in the design. The ethics factor expressed the legal and ethical issues that should be considered when using technology in the learning-teaching process. Finally, the specialization factor included teachers' leadership skills for the effective use of technology in the learning-teaching process. Responses to the scale items used five-point Likert answers. Cronbach's alpha of the scale was calculated as.95. Cronbach's alpha of the scale's factors was between .85 and .92. In addition, Pearson's coefficient from the re-test was found to be r= 80. All items in the scale were positive. In this study, the Cronbach alpha coefficient of the scale was examined, and .96 was found. Based on this result, the scale can be said to be reliable.

4. 21st-century skills competence perception scale: A 21st-century skills competence perception scale, developed by Anagun, Atalay, Kilic, and Yasar (2016), was used to prepare the tool for this study. Exploratory and confirmatory factor analyses were used while developing the scale. The scale was developed by applying it to 330 prospective teachers. Using an exploratory factor analysis, the scale was found to comprise 3 factors and 42 items. The factor loads of the scale varied between

.40 and .80. The dimensions of the scale explained 51.30% of the total variance. The reliability coefficient of the scale was .88. The confirmatory factor analysis performed while developing the scale showed that the fit indices were appropriate (Anagun et al., 2016). In this study, the Cronbach alpha coefficient of the scale was examined and found to be .96, so the scale was deemed reliable.

Data Collection

The data of the research were collected in the 2019-2020 academic year. The pre-test data of the study were collected one week before the application. The post-test data of the study were collected one week after the application was completed. The final test data were collected by preparing an online form due to the Covid 19 pandemic. Before conducting the research, necessary permission was obtained from the dean of the faculty of education. Ethics committee decision was also taken (Date: 01/04/2020, No: 874329561050'991/89-3). All ethical principles were complied by the researcher during data collection process. The participants of the research participated in the research within the scope of the principle of voluntariness.

Data Analysis

The data were examined before the univariate normality assumption was met before analysis. Shapiro-Wilks test was examined to determine whether the univariate normality assumption was met. The results showed that the experimental group's digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perception, and the control group's digital literacy self-efficacy and 21st-century skills competency perception posttest scores were not normally distributed (p<.05). Can (2019) has suggested that if the Shapiro-Wilks analysis is significant, the skewness and kurtosis coefficients should be examined. According to Can (2019),the skewness and kurtosis coefficient between +1.96 and -1.96 indicates that the data are normally distributed. Based on that reference, it can be said that the experimental group's digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perception, the control group's digital literacy self-efficacy, and 21st-century skills competency perception posttest scores were normally distributed.

Descriptive statistics, t-tests for independent groups, and MANOVA were used in this research. To use a t-test for independent groups, the assumption must be met that the dependent measurement should show a normal distribution in both groups and that the variance of the two groups in the dependent variable was equal, that is, homogeneous (İyilikçi, 2020, p. 174). The results of this study showed that these two assumptions were met. In MANOVA, the sample size is an important issue. Pallant (2005) stated that the number of samples in each group should be more than the dependent variable. This situation is suggested for both power thinking and evaluation of the homogeneity of variance-covariance matrices. The number of dependent variables in the study was three, and the number of students in the study group was 68.So, the number of students overall was higher than the number of students required for each cell, so the number of samples can be said to be sufficient for analysis (Tabachnick & Fidell, 2007, p. 317). To perform MANOVA analysis, the assumption of single and multivariate normality must be met. The results shows that the univariate normality assumption was met. Therefore, Mahalanobis and Cook's distance and leverage values were examined (Seçer, 2015). The Mahalanobis value was less than 16.27, Cook's distance was less than .40, and the leverage value was less than .050. Based on these results, it can be said that the multivariate normality assumption was met. To make MANOVA, there should be no multiple linear relations. Field (2009) stated that there should be a moderate linear relationship between dependent variables in MANOVA. Akbulut (2011) stated that this relationship should be no lower than.10 and no higher than .90.The results of this analysis showed that there was no linear correlation problem.

Another assumption that must be met to make MANOVA is to meet the variance and covariance homogeneity. Whether or not this condition is met is determined by the "Box's M"test. The fact that the Box's M test was not statistically significant indicated that the assumption of homogeneity of variance-covariance matrices was met and that this assumption was violated. In this study, the significance criterion for Box's M test was taken as .05, which is in accord with Secer (2015). Tabachnick and Fidell (2007, p. 271) suggested that if the assumptions of MANOVA are violated, the value of Pillai's Trace should be examined instead of Wilks' Lambda. Therefore, in this study, Pillai's Trace value was examined. According to Green and Salkind (2013), in MANOVA, the effect size value ($\eta 2$) is evaluated as.01 small, .06 medium and.14 large. The impact magnitude also is included in the related tables.

RESULTS

In this section, the results for the two research questions are in order.

1. Results Regarding the Difference Between the Pretest-Posttest Scores of the Experimental Groups

Whether there is a significant difference between the pretest and posttest scores of the prospective teachers in the experimental group was examined. A one-way repeated MANOVA was conducted on the differences between the pretest and posttest scores of the experimental group on digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perception. The results are presented in Table 4.

Table 4. One-way repeated MANOVA results of the pretest and posttests of the experimental group

Variable	Test	N	$\overline{X}$	SS	sd	F	P	η^2	*LSD*
Digital literacy self-efficacy	Pretest (A)	36	3.28	.75	1-70	105.60	.00*	.60	B>A
	Posttest (B)	36	4.64	.26					
Technopedagogical education competence	Pretest (A)	36	3.15	.75	1-70	140.20	.00*	.66	B>A
	Posttest (B)	36	4.71	.22					
21st-century skills competence perception	Pretest (A)	36	3.32	.74	1-70	110.00	.00*	.61	B>A
	Posttest (B)	36	4.70	.25					

*p < .05

In the one-way repeated MANOVA, digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perception were dependent variables, and the pretest and posttest scores of the experimental group were independent variables. Before executing one-way repeated MANOVA, the assumptions of normality, univariate, and multivariate extreme values, linearity, multiple correlation problem, and homogeneity of variance-covariance matrices were found, and the variance-covariance matrix homogeneity and variance equation proposal were violated. In that case, Pillai's Trace test was examined instead of Wilks' Lambda test. A statistically significant difference was found between the pre-posttest scores of the experimental group in the context of combined dependent variables ($F_{(1-70)}$ =51.714, p=.00; Pillai's Trace=.695; $\eta 2$=.69).

The one-way repeated MANOVA results in Table 4 show that there was a significant difference in favor of posttest scores over the pretest score. The digital literacy self-efficacy of the experimental group ($F_{(1-70)}$=105.60, p<.05), technopedagogical education competence ($F_{(1-70)}$=140.20, p<.05), and 21st-century skills competence perception ($F_{(1-70)}$=110.00, p<.05).The eta square values showed that there was a high level of effect.

2. Results Regarding the Difference Between the Pretest-Posttest Scores of the Control Groups

Whether there was a significant difference between the pretest and posttest scores of the prospective teachers in the control group was examined. A one-way repeated MANOVA was conducted on the differences between the pretest and posttest scores of the control group on digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perception. The results are presented in Table 5.

Table 5. One-way repeated MANOVA results of the pretest and posttests of the control group

Variable	Test	N	$\overline{X}$	SS	sd	F	P	η^2	*LSD*
Digital literacy self-efficacy	Pretest (A)	32	3.61	.64	1-62	37.341	.00*	.37	B>A
	Posttest (B)	32	4.44	.42					
Technopedagogical education competence	Pretest (A)	32	3.41	.61	1-62	57.207	.00*	.48	B>A
	Posttest (B)	32	4.35	.34					
21st-century skills competence perception	Pretest (A)	32	3.62	.50	1-62	40.191	.00*	.39	B>A
	Posttest (B)	32	4.37	.43					

*$p < .05$

In the one-way repeated MANOVA, digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perception were dependent variables, and the pretest and posttest scores of the control group were independent variables. Before executing one-way repeated MANOVA, the assumptions of normality, univariate, and multivariate extreme values, linearity, multiple correlation problem, and homogeneity of variance-covariance matrices were found, and the variance-covariance matrix homogeneity and variance equation proposal were violated. Here, Pillai’s Trace test was examined instead of Wilks’ Lambda test. A statistically significant difference was found between the pre-posttest scores of the control group in the context of combined dependent variables($F_{(1-62)}$=24.737, p=.00; Pillai’s Trace=.553; η2=55).

The one-way repeated MANOVA results in Table 5 show that there was a significant difference in favor of posttest scores over the pretest score.The digital literacy self-efficacy of the control group ($F_{(1-62)}$=37.341, p<.05), technopedagogical education competence($F_{(1-62)}$=57.207, p<.05),and 21st-century skills adequacy perception ($F_{(1-62)}$=40.191, p<.05).The eta square values showed that there was a high level of effect.

3.Results Regarding the Difference Between Posttest Scores of Experimental and Control Groups

Whether there was a significant difference between the posttest scores of prospective teachers in the experimental group and the control group was examined. A one-way MANOVA was conducted on the difference between the posttest scores of the experimental and control groups on digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perception. The results are presented in Table 6.

Table 6. One-way MANOVA results of the posttests of the experimental and control groups

Variable	Group	N	$\overline{X}$	SS	sd	F	P	η^2	*LSD*
Digital literacy self-efficacy	Experimental (A)	36	4.64	.26	1-66	5.576	.02*	.07	A>B
	Control (B)	32	4.44	.42					
Technopedagogical education competence	Experimental (A)	36	4.71	.22	1-66	25.875	.00*	.28	A>B
	Control (B)	32	4.35	.34					
21st-century skills competence perception	Experimental (A)	36	4.70	.25	1-66	14.815	.00*	.18	A>B
	Control (B)	32	4.37	.43					

*$p < .05$

In the one-way MANOVA, digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perception were dependent variables, and the experimental group and the control group were independent variables. Before executing one-way MANOVA, the assumptions of normality, univariate, and multivariate extreme values, linearity, multiple correlation problem, and homogeneity of variance-covariance matrices were found, and the variance-covariance matrix homogeneity and variance equation proposal were violated In this case, Pillai's Trace test was examined instead of Wilks' Lambda test. A statistically significant difference was found between the posttest scores of the experimental and control groups in the context of combined dependent variables ($F_{(1-66)}$=8.727, *p*=.00; Pillai's Trace=.290; η2=.29).

The one-way MANOVA results in Table 6 show that there was a significant difference in favor of the experimental group. The digital literacy self-efficacy of the experiment and control groups ($F_{(1-66)}$=5.576, *p*<.05), technopedagogical education competence ($F_{(1-66)}$=25.875, *p*<.05),and 21st-century skills adequacy perception ($F_{(1-66)}$=14.815, *p*< .05).The eta square values showed that there was a high level of effect.

DISCUSSION

Developments and changes in science and technology in the twenty-first century affected all areas of life, including the field of education. In education, it has become necessary to organize learning-teaching environments for individuals to keep up with technological developments. In this way, the needs of the Z generation will be met. The most prominent features of the Z generation are that they use digital technology very frequently in their daily lives (Polakova & Klimova, 2019; Pousson & Myers, 2018). This study explored how well digital literacy self-efficacy, technopedagogical education competencies, and 21st-century skills competency perceptions were developed in prospective teachers in the Z generation.

The first sub-problem of the study asked whether there was a significant difference between the pretest-posttest scores of the experimental group's digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perception scales. The results showed a significant difference in favor of the posttest scores of the prospective teachers in the experimental group. Based on that result, it can be said that cooperative learning based on the flipped classroom model applied in the experimental group had a significant effect on the digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perception in the experimental group. The inverse classroom model and the cooperative learning model are student-centered models. Student-centered models are models that students actively participate in the process and are responsible for their own learning (Bayrakceken et al., 2015; Bishop & Verleger, 2013; Flumerfelt & Green, 2013; Foldnes, 2016; Fulton, 2012). In this study, the student candidates in the experimental group were encouraged to be active and take part in the process by applying cooperative learning activities based on the inverted model. It can be said that these activities significantly affected the pre-service teachers' digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perceptions. Ozdemir (2019) concluded that the flipped classroom model increased the pre-service teachers' attitudes towards geometry. Duman (2019) found that the flipped classroom model affected the academic success and learning motivations of prospective teachers. Similarly, Gua, Tian, and Liu (2018), Erbil (2019), and Zhang (2018) reached the conclusion that cooperative learning based on a flipped classroom model increased students' academic success.

The second subproblem of the study investigated whether there was a significant difference between the pretest-posttest scores of the control group's digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perception scales. The results showed a significant difference in favor of the posttest scores of the prospective teachers in the control group. Based on that result, it can be said that the cooperative learning model applied in the control group had a significant effect on the pre-service teachers' digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perception. The cooperative learning model was used with the control group. In this model, two or more people come together to benefit from each other's knowledge and feed on each other's knowledge. In this study, students worked in small groups, and all of them were encouraged to take an active role and build on each other's information (Barkley, Cross & Major, 2004). In this study, various activities were used with prospective teachers in the control group based on the cooperative learning model. It was ensured that prospective teachers were responsible for each other's learning by forming heterogeneous groups. Attention was paid to the pre-service teachers' active participation in group work by performing duties and taking responsibility for the activities carried out. Particular attention was paid to the principle of "all of us, one of us for all," and the researcher provided the necessary guidance to ensure cooperation in the groups. The objective was to develop a positive dependence among the group members. It can be said that all these student-centered activities improved the pre-service teachers' digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perception. Sosyal (2019) concluded that the cooperative learning model had a significant effect on students' 21st-century learning and innovative skills. The result of this experiment supports that conclusion. Moreover, Arslan (2016) concluded that the cooperative learning model increased the academic success of prospective teachers.

Finally, this study examined whether there was a significant difference between the posttest scores of the experimental group and the control group on digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perception. The results showed a significant difference in favor of the posttest score of the experimental group. Therefore, it can be said that cooperative learning based on the flipped classroom model used with the experimental group was more effective than using only the cooperative learning model with the control group. In addition, the high eta square value calculated for the posttests for the experimental group supported this result. Accordingly, it can be said that cooperative learning activities based on the flipped classroom model are more effective on digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perceptions compared to cooperative learning activities alone.

Prospective teachers in the experimental and control groups are in the Z generation. The main feature of that generation is that they are intertwined with technology, especially digital technology (Polakova & Klimova, 2019). So, it can be said that cooperative learning activities based on the inverted model used with the experimental group are more effective on prospective teachers. The fact that the flipped classroom model has not been implemented with the prospective teachers in this study might be traced to the teaching management system. In fact, the researcher observed that the prospective teachers were more willing to participate in the lessons, actively participated in the lessons, and fulfilled all the duties and responsibilities for using the teaching management system based on the flipped classroom model. As a result, it can be said that the application of technology in support of teaching-learning models in line with the needs of prospective teachers. It enables students to participate actively in the lesson, and it improves their perception of digital literacy self-efficacy, technopedagogical education competencies, and 21st-century skills self-efficacy. Prior studies that compared the flipped classroom model with traditional methods and techniques found that there was greater academic success in groups where the flipped classroom model was used (Aycicek & Yanpar-Yelken, 2018; Elian & Hamaidi, 2018; Ozdemir, 2017; Ozyurt & Ozyurt, 2018; Lee & Wallace, 2018; Turan, 2015). Their results showed that the flipped classroom model had a significant impact on students. In the research conducted by Debbag (2018), it was revealed that the academic success, motivation, self-efficacy, and attitude towards the lesson in students trained with the flipped classroom model were more permanent than a control group that did not have that experience. This study coincides with those results.

CONCLUSION

This research has shown that cooperative learning based on the flipped classroom model used with the experimental group and the cooperative learning model used with the control group were both significantly effective in developing the pre-service teachers' digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perceptions. The results show that student-centered models improve students' digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perceptions. In this regard, the use of student-centered models in higher education institutions will be very useful for students to gain twenty-first-century skills. However, this study showed that cooperative learning used in conjunction with the flipped classroom model was more effective than the cooperative learning model used alone. This leads to the conclusion that technology-based models are more effective in educating students. It is thought that the results of this research are very important and that they have made an important contribution to the literature.

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The results of the research, generalizations are made based on the results of a state university in Turkey can be expressed as a limitation can not be done. Therefore, the different regions of Turkey, unlike the colleges and in the execution of similar research on teacher candidates studying in different parts of the research results will contribute to generalizable. It is also important to use qualitative data collection tools to analyze the results of the research in more depth. Another limitation of this research is the lack of qualitative data collection tools.In later studies,in-depth researches will also be used in the literature by using qualitative data tools.

SUGGESTIONS

Based on this study, the following suggestions have been developed:

1. As a result of the research, cooperative learning based on the flipped classroom model conducted on the prospective teachers in the experimental group, and the cooperative learning model based activities conducted on the prospective teachers in the control group had a significant effect on the digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competence perception. Therefore, it is recommended that technology-based student-centered models be applied in teacher training programs. In this way, digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perceptions can be developed, and prospective teachers can be trained.

2. Experimental studies can be conducted in different teacher training programs and in different courses about the flipped classroom model and the cooperative learning model.

3. Conducting research in which different models and patterns such as case studies, mixed research models, and action research to examine the digital literacy self-efficacy, technopedagogical education competence, and 21st-century skills competency perception of the cooperative learning model with the flipped classroom model will contribute to the literature.

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