Empirical Article

The Effect of Electronic Portfolio Use on Pre-Service Elementary Teachers' Academic Achievement Levels and Self-Efficacy Beliefs Regarding the Teaching Process

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Abstract

It is important to use technology in the education of teacher candidates in higher education in Turkey. These technology uses also affect the cognitive development of teacher candidates. It is necessary for pre-service teachers to use an electronic portfolio, one of the technological developments, and to determine the effects of this on the pre-service teacher. This study aims to determine the effect of using an electronic portfolio on pre-service elementary teachers' academic achievement levels and self-efficacy beliefs regarding the teaching process. A mixed-method approach involving 61 participants lasted for 14 weeks with volunteer pre-service teachers participating. Through parametric test techniques, and descriptive and content analysis, findings from this study showed that the use of e-portfolio positively affected the self-efficacy beliefs and academic achievement levels of pre-service elementary teachers. In addition, a linear relationship was found between self-efficacy beliefs and academic achievement. It is important to have infrastructure and technological competencies in similar studies.

The integration and use of technology in the education-teaching process is increasing. In order to integrate technology into the teaching process, teachers and pre-service teachers need to improve themselves in the use of technology and increase their self-efficacy in this regard (Ritzhaupt et al., 2010). The development of teachers' self-efficacy beliefs in any subject or subjects provides the development of lifelong learning skills. These skills are the ability to self-manage professional development needs such as solving problems, working independently or in a team, communicating effectively, learning, teaching and using technology (Heinrich et al., 2007). It is thought that these skills,

which are acquired through self-efficacy belief, will be effective in improving both themselves and their students (Yorgancı & Bozgeyikli, 2016). It is known that pre-service teachers have high self-efficacy beliefs to teach before starting their profession. This belief is aimed at educating themselves at the best possible level in every aspect (Bahçivan & Aydin, 2020). Due to the development of today's digital technologies, the use of technology in education, and the advantages of technology use in education, it is important for pre-service teachers to have self-efficacy beliefs in learning and teaching the use of technology in the professional development process. Because it is known that, the developing technology reflects the education process and provides convenience (Akpınar, 2003).

In today's era, integrating digital technology into the assessment process has become a very important need. Teachers aim to facilitate the assessment process by saving both stationery equipment and time by using alternative assessment methods in addition to traditional assessment methods (Akbaş & Gençtürk, 2013; Gelbal & Kelecioğlu, 2007). Authentic assessment, also known as performance and direct assessment, is a task-oriented assessment method that helps a learner master a specific content area. The focus of authentic assessment is to evaluate the student's performance on a specific task that uses learned knowledge and skills in a realistic environment (Montgomery, 2001). As an example of alternative assessment; exhibitions, writing assignments, reflections, journals and portfolios etc. (Herman et al., 1992). With the development of technology, the use of portfolios becomes easier. Electronic portfolios (e-portfolios), known as files stored in digital media, eliminate the costs of using materials such as paper, ink, toner, and binding (Alshawi & Alshumaimeri, 2017). The accessibility and ease of use of information and communication technology show that an e-portfolio is no longer a used concept but an application method (Meeus et al., 2006). It also provides ease of collaboration using digital space and shared files. It is used not only in the educational environment, but also in the office, storing the performance of company employees, keeping the information or teaching materials of staff or teachers (Wilson, 2018), and even in many recruitment processes, especially teachers (Painter & Wetzel, 2005; Strawhecker et al., 2007). Apart from these, it is also used to store student products and evaluate the process in the education process (Author, 2020).

Conceptual and Theoretical Background

E-portfolio

With the development of computer technologies, keeping student records electronically has become very popular (Banister et al., 2006). E-portfolios are files in computer environments where students' work, achievements, and visual and audio products such as text, pictures, video, and audio are stored during the learning process (Abrami & Barrett, 2005; Gatlin & Jacob, 2002). E-portfolios are usually a collection of a student's experience and skills and are managed by a web software program. Concerns about the authenticity of e-portfolios are valid, as with any digital document or online representation. However, some measures can be taken to protect the integrity of e-portfolios and ensure their authenticity. Here are some points to consider:

Verification processes: Implementing a verification process can help confirm the authenticity of e-portfolios. This could involve cross-referencing the information provided in the e-portfolio with reliable sources, such as educational institutions, employers, or professional organizations. Additionally, using digital signature technologies or issuing certificates can enhance the credibility of the e-portfolio.

Multi-modal evidence: E-portfolios can incorporate various forms of evidence, including written documents, images, videos, and audio recordings. By including multiple forms of evidence, it becomes more challenging to fabricate an entire e-portfolio convincingly. Authenticating different types of evidence can add another layer of credibility.

Secure platforms: Using secure and reputable platforms or systems for hosting and sharing e-portfolios is crucial. These platforms should employ robust security measures to protect against tampering or unauthorized access. Encryption, access controls, and regular security audits are essential features to ensure the integrity of the e-portfolios.

Collaborative assessment: In certain contexts, involving multiple assessors or reviewers can help verify the authenticity of an e-portfolio. Each assessor can bring a unique perspective and expertise to the evaluation process, reducing the likelihood of manipulation or misrepresentation.

Peer review: Peer review processes, where e-portfolios are assessed by peers or subject matter experts, can act as a form of validation. Peers can provide feedback, ask questions, and share their expertise to verify the authenticity and accuracy of the e-portfolio content.

Continuous monitoring: Regularly reviewing and updating e-portfolios can help identify any inconsistencies or discrepancies over time. This can be done by individuals themselves, educational institutions, or employers, depending on the purpose of the e-portfolio. Periodic checks can help ensure that the information remains accurate and up-to-date.

Digital forensics: In cases where there are concerns about the authenticity of an e-portfolio, digital forensics techniques can be employed. These techniques involve analyzing digital artifacts, metadata, and other relevant information to verify the integrity and origins of the e-portfolio content.

Overall, a combination of verification processes, secure platforms, collaborative assessment, peer review, continuous monitoring, and digital forensics can help protect the integrity of e-portfolios and address concerns about authenticity.

They are available for students of all school levels. However, it is possible to create an e-portfolio not only for students but also for teachers and pre-service teachers. In this respect, files containing all the activities that make up the curriculum vitae of pre-service teachers, such as monitoring their development throughout their vocational education processes, and personal and academic achievements, are also known as e-portfolios (Whitfield, 2011).

The use of e-portfolios in a teacher's in-service program can be an effective strategy for organizing and presenting evidence of their professional development. At the same time, e-portfolios can also serve as a valuable tool for integrating technology into the classroom, fostering the development of digital literacy skills, and facilitating communication and collaboration between teachers, students, and parents.

Self-efficacy

Self-efficacy is an essential part of Bandura's social cognitive theory. It is a concept that affects an individual's cognitive, motivational, affective aspects and preferences (Bandura, 1989). It can basically be defined as the individual's desire or motivation to take action (Brant & Willox, 2020). Every individual has self-efficacy for every situation. A student's self-efficacy to be successful in his courses and a teacher's self-efficacy to complete his professional development can be given as examples. In particular, teachers' self-efficacy is of great importance as they both aim to improve themselves and include effective guidance and teaching activities for their students. In general, a teacher's self-efficacy belief, it includes plans to set goals, manage behavior, self-regulate, and perform teaching-related tasks (Clark, 2020).

It is known that pre-service teachers' beliefs about being able to practice the profession before starting the profession are higher than their belief status after starting the profession (Bahçivan & Aydin, 2020). Actually, the state of being able to practice the profession differs from the theoretical teachings. Teachers who start their profession need portfolios in order to be able to live easily and act quickly in subjects such as student follow-up, recognition, and evaluation of products in the education and training process. In this respect, the teacher's positive self-efficacy belief in the integration of changing and developing technology and using e-portfolio skills will facilitate the learning and teaching process. It is known that with the increasing use of technology in educational environments, teachers and pre-services teachers need to improve themselves in the use of technology (Sa'ari et al., 2005).

Learning and using e-portfolios, which are used especially in the "evaluation" of teaching, is one of the issues that attract attention in connection with technology. Teachers need to learn the e-portfolio and be able to use it actively in educational environments in order to both improve themselves and follow students. In fact, it can be said that the use of e-portfolio affects the development of high-level mental skills in students (Meyer et al., 2013; Polat Demir & Kutlu, 2016). It is known that the development of high-level mental skills of students such as thinking, analyzing and synthesizing affects

their success in school life and therefore their academic studies, and as a result, their self-efficacy beliefs develop positively. As a matter of fact, it has been determined in studies that the use of e-portfolios also affects the development of individual competencies such as self-evaluation and self-management (Akgün & Şahin Kölemen, 2020; Ayan, 2010). Therefore, it can be said that the use of e-portfolios in the education process improves high-level mental skills and indirectly self-efficacy. However, it is thought that success is related to self-efficacy and that increasing success causes an increase in self-efficacy (Haidt & Robin, 1999; Koca & Dadandı, 2019; Tunca & Alkın-Şahin, 2014).

Theoretical structure

The use of e-portfolio is important in ensuring the professional development of pre-services teachers and gaining teaching skills in higher education institutions. Meeus et al., (2006) stated in their study that the e-portfolio, which is student-centered and focused on using digital technologies, provides "proficiency", "action" and "thinking" cycles in pre-services teachers. It is thought that pre-services teachers gain various competencies, especially the development of metacognitive skills. Because of using e-portfolio, pre-service teachers' own metacognitive development is ensured (Filkins, 2010). In other words, it is known that digital technologies encourage pre-services teachers to think (Kloser et al, 2020). Thanks to the e-portfolio, pre-services teachers can make self-regulation by following their own works and products (Meyer et al., 2011). This situation affects the competency of pre-services teachers. Competency includes all the changes that occur in pre-services teachers during the teaching process. It is better to focus on a specific area, as it is quite difficult to identify all the changes in pre-services teachers. The purpose of using e-portfolio is to provide pre-service teachers with the ability to gain experience using e-portfolio (Heinrich et al., 2007; Meeus et al., 2006). At this point, it is very important to have better equipped teachers who have gained experience in raising their own students (Gatlin & Jacob, 2002). In the process of using the e-portfolio, the self-efficacy status of the pre-service teacher can also be examined. In addition, at the end of the e-portfolio usage process, there is a situation of action and reflection. In the aforementioned study, the academic achievement status of pre-services teachers was considered as an indicator of this.

Pre-service teacher program in Turkey

When the history of teacher training is examined, it is understood that it is a system that started in the Ottoman period and continues today. The foundation of the first teacher training schools in Turkey was laid in 1848 during the Ottoman period. These schools, called "*Darülmüalime*", started to train teachers in 1851. Students were selected through an examination among the candidates (Akyüz, 2001). It is known that the students selected and educated in these schools can be appointed as teachers upon meeting two conditions in addition to their education. In teaching assignments made at the end of 3 years of education, they are required to demonstrate good behavior and know Arabic and Turkish at a good level (Atanur Başkan et al., 2006).

These schools were named "Teacher (Muallim) School" in 1924 and "Teacher School" in 1935 with the establishment of the republic. These schools continued their education with minor changes until 1974. In 1974, in addition to all kinds of teacher training laws, two-year education institutes were opened to train primary school teachers. In 1982, these institutes were transformed into four-year faculties. In 1993, as today, primary school teachers receive education in education faculties for four years within the scope of classroom teaching (Akdemir, 2013).

Teacher candidates are given the opportunity to improve themselves by taking courses in the fields of formation, field proficiency, and professional competence during their undergraduate education. In particular, classroom teachers receive extra training in areas such as laboratories, technology, and special education (CoHE, 2007). It is aimed to improve the technological competence of teachers in higher education. In addition, the developments of alternative evaluation tools or data collection tools are among the desired objectives.

Purpose and importance of the research

The use of e-portfolios is important in subjects such as the use of technological developments in the learning and teaching environment, the professional development of pre-service teachers, and student follow-up. A process expected to be used in the educational environment as well as the use of changing and rapidly developing technology in all areas of life. It is known that these technological developments used enable teachers and pre-service teachers to gain professional competence. In particular, the ability to monitor all developmental activities of all students in a classroom together and regularly throughout the process provides convenience for teachers and pre-service teachers. It is an important development that the student's all kinds of activity or activity processes and the products at the end of it are collected and can be examined or evaluated at any time and anywhere. In addition, it can be said that the use of e-portfolio and the development of high-level thinking skills and self-efficacy beliefs of teachers or students also affect the development of lifelong learning skills. With this study, guidance was given to teacher candidates studying in higher education to improve themselves. The pre-service teacher develops their self-efficacy for using e-portfolio in higher education and for self-development by realizing its effect on students. This study, it is aimed to contribute to the development of teacher training programs in the higher education community.

This study aims to determine the effect of using an e-portfolio on pre-service elementary teachers' academic achievement levels and self-efficacy beliefs regarding the teaching process. In this context, the accuracy of the following hypotheses was investigated. Appropriate research questions were formed to reach these hypotheses.

Hypotheses

H1. The use of e-portfolio positively affects pre-service elementary teachers' self-efficacy beliefs.

H2. The use of e-portfolio positively affects the academic achievement of pre-service elementary teacher.

H3. Pre-service teachers have positive opinions about the effect of using e-portfolio in the teaching process on self-efficacy beliefs and academic achievement.

H4. There is a linear relationship between pre-service elementary teachers' self-efficacy beliefs and their academic achievement in assessment and evaluation course.

Research questions

1. Does the use of e-portfolio cause a significant difference in the self-efficacy beliefs of pre-service elementary teachers' regarding the teaching process?

2. Does the use of e-portfolio cause a significant difference in the academic achievement levels of pre-service elementary teachers'?

3. What are the views of pre-service teachers' on the effect of using e-portfolio in the teaching process on self-efficacy beliefs and academic achievement?

4. What is the relationship between pre-service teachers' self-efficacy beliefs and their academic achievement levels?

Method

Research Design

In the research, quasi-experimental design with pre-posttest control group was used. The quasi-experimental design is used when working on existing groups when participants cannot be randomly assigned to groups (Büyüköztürk, 2009; Çepni, 2010). One of the quasi-experimental designs, the pre-posttest control group design examines the effect of the experimental procedure on the dependent variable (Fraenkel et al., 2012). In the experimental group, the "Measurement and Evaluation in Education Course" was carried out with an e-portfolio. In the control group, pre-service elementary teachers taught according to the current teaching activity within the scope of this course. It was also supported by qualitative data embedded in the experimental design. It has been used in qualitative data to increase the objectivity of quantitative data and

to increase the usefulness of research results (Creswell & Plano Clark, 2015). Qualitative data in the research were collected through face-to-face interviews. In this study, it was aimed to determine the effects of the qualitative dimension and the use of e-portfolio on pre-service teachers' self-efficacy beliefs about the teaching process and academic achievement. The research lasted for 42 hours (14 weeks).

Participants

The research was conducted with 3rd year students studying in the Classroom Teaching programme of a state university in Turkey, in the spring semester of the 2019-2020 academic years. In the study experimental and control group, the lessons were taught online through the zoom program. The lessons were taught online due to the coronavirus (covid-19) outbreak that occurred worldwide. One of the two groups participating in the study was randomly determined as the experimental group (N: 30) and the other as the control group (N: 31). While the lessons in the experimental group were taught in the computer laboratory, the lessons in the control group were taught in a normal classroom environment. In order to eliminate the teacher difference in the groups, the lessons were conducted by the researcher in both the experimental and control groups. Qualitative data were collected by randomly selecting 13 volunteer pre-services teachers in the experimental group. The general characteristics of the participants are given in Table 1 (EG: Experimental Group, CG: Control Group). These data are given in order to understand participant characteristics in the eyes of the reader and to clearly understand the relationships between research questions and participant characteristics.

Table 1

Participant Characteristics I

Groups	Gender		Parents' Profession		Internet Access		Teaching Experience	
	Female	Male	Teacher	Others	Yes	No	Yes	No
EG	27	3	1	29	29	1	9	21
CG	28	3	4	27	30	1	5	26

According to Table 1, it can be said that the experimental and control groups showed similar characteristics in areas such as gender, parents profession, internet access and teaching experiences. Accordingly, the majority of the participants are women. It can be said that the parents of one participant in the experimental group and four in the control group are teachers; therefore, they know the teaching profession. Almost all of the participants have internet access whenever they want. Finally, it was determined that nine participants from the experimental group and five participants from the control group had experience in the teaching profession. Apart from these data, other demographic characteristics of the participants are given in Table 2.

According to Table 2, it is understood that the majority of the participants have one or two siblings (One participant in the experimental and control groups does not have a sibling). It is seen that the majority of the participants graduated from high schools called "Anatolian high schools". In addition, it is understood that the family income level of the majority of the participants is at a middle level. Apart from these, the data on the pre-application academic achievement and self-efficacy beliefs of the participants are presented in Table 3.

As seen in Table 3, there is no significant difference between the experimental and control groups in terms of academic achievement pre-test results ($p > 0.05$), while there is a significant difference between the groups in terms of self-efficacy beliefs of the experimental and control groups before the research ($p < 0.05$). 0.05). It is seen that this difference in self-efficacy beliefs is in favor of the control group (Mean (KG) = 4.02 > Mean (EG) = 3.37). As a result, it can be

Table 2

Participant Characteristics II

Groups	Number of Siblings				Type of School Graduated				Income Status		
	1	2	3	4+	Anatolian High School	Flat-Basic High School	Teacher's High School	Others	Low	Middle	High
EG	9	9	8	3	21	3	3	3	0	28	2
CG	12	10	6	2	16	9	4	2	2	27	2

Table 3.

Pre-Test Results of Participant Groups

Scales	Groups	N	Mean	Std. Deviation	t	p
Academic Achievement Test	Experiment	30	45.83	13.96	0.51	0.61
	Control	31	44.19	10.96		
Self-Efficacy Belief Scale	Experiment	30	3.37	0.40	-6.17	0.00*
	Control	31	4.02	0.41		

* $p < 0.05$

said that while there is no difference between the experimental and control groups in terms of academic achievement before the research, there is a difference in favor of the pre-service teachers in the control group in terms of self-efficacy beliefs.

Data collection tools

In the study, a self-efficacy belief scale and academic achievement test were used to collect quantitative data. In the process of collecting qualitative data, face-to-face interviews were conducted. Information and reliability-validity values for these tools are presented below.

Pre-service teachers' self-efficacy belief scale regarding the teaching process: It was used to determine pre-service teachers' self-efficacy regarding the teaching process. This scale was developed by Özdemir (2008) for pre-service teachers. The scale was used with permission from the author. The scale is a 5-point Likert type and consists of 40 items. The scale consists of three sub-dimensions: planning (8 items), implementation (19 items), and evaluation (13 items). In the reliability analysis, Cronbach's alpha internal consistency coefficient was found to be 0.67 for the first dimension (planning) of the scale, 0.84 for the second dimension (application), and 0.76 for the third dimension (evaluation). The internal consistency coefficient for the whole scale was calculated as 0.88. For this study, Cronbach's alpha internal consistency coefficient was

found to be 0.85 for the planning sub-dimension, 0.91 for the implementation sub-dimension, and 0.90 for the evaluation sub-dimension. The internal consistency coefficient for the whole scale was calculated as 0.95.

Academic Achievement Test; It was used to determine the success of pre-service teachers for measurement and evaluation. This test was selected from the *Public Personnel Selection Exam (PPSE)* questions applied in Turkey in previous years. The researchers made subject-specific question selections. Although it is assumed that the reliability, validity, and item analyses of these test items used in national exams were made beforehand, item analyses were re-done in this study. Accordingly, while the difficulty indexes of the items in the scale ranged between 0.40 and 0.74, it was determined that there was an accumulation of around 0.70. Similarly, item discrimination indices were found to be between 0.20 and 0.40. Based on these data, the average item difficulty index of the test was calculated as 0.71 (easy), and the distinguishing feature of the test was calculated as 0.31 (good item). In addition, the KR-20 reliability coefficient for the whole test was found to be 0.74.

Interview: To support the quantitative data in the research, qualitative data were collected through interviews. In the interview, questions prepared by the researchers by taking expert opinions and appropriate probes were used. Within the scope of the reliability and validity of the interview method; Participant characteristics are presented in detail in order to understand the answers given. In addition, participant citations are given in the findings section as well. The analyzes made by two experts with doctoral degrees in the classroom teaching program and e-portfolio were evaluated based on consensus. Accordingly, 90% consensus was reached on the trilogy of code-category and theme. As a matter of fact, according to Miles and Huberman (1994), it can be said that the consensus of 80% and above is reliable.

Analysis of data

In the analysis of the quantitative data, in the comparison of the scores on academic achievement and self-efficacy beliefs of the pre-service teachers in the experimental and control groups, the variances were homogeneous (homogeneity, p=0.19; p> 0.05), the data showed a normal distribution (Shapiro-Wilk= 0.12; p> 0.05), the sample groups were since the numbers were 30 or more, "Two-Factor ANOVA for Mixed Measures" and "Covariance Analysis (ANCOVA)" tests, which are parametric tests, were used in the study. It was observed that there was a significant difference in favor of the control group between the pre-test scores of the pre-test self-efficacy beliefs about the teaching process of the pre-service elementary teachers in the experimental and control groups. For this reason, "single factor analysis of covariance (ANCOVA)" was used to compare the self-efficacy beliefs of the groups. For this, the assumptions were checked first, and as a result of the Levene test, it was seen that the homogeneity assumptions of the variances were met and the result of the Levene test was greater than 0.05. It was determined that the within-group regression slopes (regression coefficients) of the groups were equal (p= 0.20; p>0.05) and there was a linear relationship between the groups in the correlation analysis performed between the groups. In the analysis of the scores related to self-efficacy beliefs towards the teaching process, the pretests were defined as covariant variables and the difference between the corrected posttest mean scores was examined.

The covariance of the groups was also found to be equal for the pairwise combinations of the measurement sets obtained from the groups of the Measurement and Evaluation achievement test scores (p=0.61; p>0.05). Considering these data results, the "two-factor ANOVA test for mixed measures" was applied because the groups met the parametric test assumptions. It is recommended that this analysis be used in designs with pre-posttest control groups (Büyüköztürk, 2019).

The eta-square (η2) correlation coefficient is frequently used to determine the effect size of the study. It explains the effect of the independent variable on the dependent variable without a linear relationship between the variables. It takes a value between 0.00 and 1.00. It is interpreted as a small effect between 0.00 and 0.01, a medium effect between 0.01 and 0.06, and a large effect between 0.06 and 0.14 (Büyüköztürk, 2017; Cohen, 1988). However, qualitative data were obtained by recording them on the recorder through face-to-face interviews. The data was then transcribed. Content analysis technique was used in the analysis of qualitative data. Qualitative data are collected for reasons such as supporting quantitative data, determining the accuracy of the findings obtained with quantitative data, and learning a finding in detail. The qualitative data in this study were analyzed to give detailed and in-depth findings of the category and thematic triad to

give detailed information about the participant quotes and to answer the research question by using "codes" from these quotes (Yıldırım & Şimşek, 2013). No computer program was used for content analysis.

Results

The findings obtained within the scope of the research are presented in the order of research hypotheses and questions.

Findings on self-efficacy beliefs regarding the teaching process; A single factor analysis of Covariance (ANCOVA) was conducted to determine whether there was a significant difference between the self-efficacy beliefs and post-test scores of the pre-service elementary teachers in the experimental and control group regarding the teaching process. The results are given in Table 4.

When Table 4 is examined, it is concluded that there is a significant difference between the self-efficacy beliefs of the pre-service teachers regarding the teaching process, and the adjusted mean scores of the experimental and control groups

Table 4

ANCOVA Results on Self-Efficacy Beliefs Regarding Teaching Process of Pre-Service Elementary Teachers in Experimental and Control Group

Source of Variance	Sum of Squares	sd	Mean Squares	F	p	η 2
Pre Test	1665.92	1	1665.92	8.45	0.00*	0.13
Groups	3185.72	1	3185.72	16.15	0.00*	0.22
Error	11440.28	58	197.25			
Total	15730.82	61				

*p<0.05

(F (1.58) = 16.15, p<0.05). In other words, it is seen that there is a significant difference between the post-test scores of the experimental and control groups. Accordingly, at the end of the study, there was a significant difference in favor of the experimental group in terms of self-efficacy belief between the experimental and control groups (Experimental group average =165.0, control group average=154,8). According to these findings, it is seen that the e-portfolio application has a significant effect on the self-efficacy beliefs of the pre-service elementary teachers' regarding the teaching process. Considering the effect size of this study, the effect size between groups is 0.22. The effect size obtained in this study has a wide effect.

Findings regarding the academic achievement levels of pre-service teachers'; the change in the academic achievement levels of pre-service teachers' because of the research is given in Table 5.
When Table 5 is examined, it is concluded that there is a significant difference between the achievement pre-test and post-test total score averages of the individuals in the experimental and control groups (F(1.59)= 7.432, p<0.05). According to this result, the changes in the groups from the pretest to the posttest are not taken into account. Considering the main effect of the measurement, it was concluded that there was a significant difference between the pre-test and post-test mean scores of the individuals in the experimental and control groups, regardless of the group (F(1.36)= 375.471, p<0.05). When the group*measurement main effect was examined, it was seen that there was a significant difference between the academic achievement post-test scores of the pre-service teachers in the experimental and control groups, but the common effects of

Table 5

Two-Factor ANOVA for Academic Achievement Post-Test Mixed Measures

Source of Variance	KT	sd	KO	F	p	η²
Between subjects	9672.13	60				
Group (Individual/group)	1082.02	1	1082.02	7.43	.01*	.11
Error	8590.11	59	145.59			
In-subjects	66871.59	61				
Measurement (Pre-Posttest)	57299.46	1	57299.46	375.47	.00*	.86
Group*Measurement	568.31	1	568.31	3.72	.06	
Error	9003.82	59	152.61			
Total	76543.72	121				

*p<0.05

repeated measurement factors on academic achievement scores were not significant (F (1.59) = 568.31, p>0.05). According to this result, it is seen that the e-portfolio application has a significant effect on the academic achievement of pre-service teachers. When the effect size of this study was examined, it was seen that the effect size was .86 for the inter-measurement and .11 for the group (Individual/group) effect. In this case, it can be said that the effect sizes obtained from the research have a large effect between the measurements, and the group (Individual/group) effect has a middle effect.

The effect of using an e-portfolio on academic achievement and self-efficacy beliefs in the teaching-learning process: In addition to the quantitative findings of the research, the qualitative findings are presented below. Qualitative data were collected under one theme and three categories. The findings were supported with appropriate quotations and coding.

Theme: The effect of using e-portfolio on academic achievement and self-efficacy beliefs in the teaching-learning process

As a result of the analysis, only 1 of 13 participants (7.69%) expressed negative thoughts regarding the use of e-portfolio, while 1 participant stated a negative aspect in addition to his / her positive thoughts. Apart from this, they stated that the use of e-portfolio by the participants affected their academic achievement and the development of their self-efficacy beliefs. The citations in question are analyzed below with their appropriate codes. Participants were coded numerically (Participant1=P1)

Category 1: The effect on self-efficacy belief: When the participant's quotations are examined, the statements related to self-efficacy belief in the process of using an e-portfolio are given below.

> *The fact that you send homework on a regular basis every week and that I see this homework has a very positive effect. Because it was followed regularly and I have the chance to repeat it thanks to this system, so I think, it has a positive effect (P3).*
> *We see our homework in a systematic way. After that, it goes in a sequence like this. Gradually, the intensity of our homework is increasing. So I definitely think it's useful. So for this, I reconciled Motivation a little bit. I also think it has partially increased our ability to use technology (P4).*
> *Something to use very well to reinforce topics. You give an activity and performance assignment that helps him measure the things he tells one-to-one, and I think it has an effect because I can see where I am and how I am after sending it (P8).*

For example, I could not use it very effectively in your first assignments. I just used your feedback to correct the answer using the copy-paste method. Then when I thought about the exams, I also increased the permanence by solving them. I saw my mistakes because you already wrote the answers clearly (P9).

It provided order for me. I was in a process where I regularly uploaded and received feedback every week. In that respect, it was good for me (P10).

Again, this is about motivation for me. I think that having activities and presentations makes learning better this way. Being in a constant activity about the lesson made the lesson more memorable for me (P11).

Here, the portfolio system actually enabled us to be active in that lesson, that is, it enabled us to be active in some way by doing those homework's, correcting the homework or making self-assessments, even if it was not face-to-face or remotely. This of course improved the motivation to learn (P13).

When the citations are examined, it is seen that factors such as being based on a "*regular*", "*followable*" and "*systematic*" order weekly, facilitating the preparation for "*exams*" with the help of "*technology*", and understanding the participant's "*own level*" (where he is) with answers and "*feedback*" have a positive effect on learning "*motivation*" and "*self-regulation*". For these reasons, it can be said that self-efficacy is positively affected by the majority of the participants in the process of using an e-portfolio.

Category 2: The effect on academic achievement: When the participant citations are examined, the statements related to academic achievement in the process of using an e-portfolio are given below.

We could get help from you. That is why it was even more efficient as there was instant feedback. I saw what we had to learn. I was seeing PPSE questions. Hani was preparing both for the exam and for the lesson. Thus, we show our shortcomings with what you need to complete (P1).

It was easier for us to reach within the scope of this course; I was able to reach every presentation instantly. Again, doing activities after each lesson made the information more permanent. Yes, there were things we practiced, for example, we were asked to prepare a rubric. After preparing the rubric, you gave feedback about it and I saw my mistakes and shortcomings in it. In this way, I think it contributed to my learning (P2).

We gained a lot of information in terms of the measurement lesson, we had the opportunity to complete them with the assignments you gave, we saw the places where you lacked feedback and we evaluated ourselves in this process. Therefore, it was a positive process (P3).

Since homework was given every week, we did this right after we saw the lesson and it stayed in our minds and we had the opportunity to repeat it because we got feedback from them, and performance assignments cover everything in that lesson, so it was a great help in our Teaching process (P7).

I think it is effective in a positive way because it ensures that the information is permanent. It makes up for our shortcomings again, and it helps a lot in terms of being permanent with the feedback you give. ... When I thought about the exam, I also increased my permanence by solving them (P9).

It became more memorable for me when I did different activities and made transactions here and saw the questions (P11).

The Word documents you provided feedback on were useful for me. The boots feature test questions were extra helpful in solving the questions in the test book (P12).

So now, from the answers you gave as feedback, I did not just say that I made a mistake, when I learned why I did it wrong, I had more information about the subject and was able to convert that minus to plus (P13).

When the citations are examined, it is understood that the participants carried out activities that affect their academic achievement with the e-portfolio usage process, such as having "*different activities*", immediate "*feedback*" on the answers to these activities, "*repeating*" when desired; solving the "*exam or questions*" related to the exam (PPSE) and making "*evaluations*" about it. In general, it can be said that the majority of the participants use expressions that positively affect academic achievement in the process of using an e-portfolio.

Category 3: Negative thoughts about the use of e-portfolio: The negative thoughts of the participants about the use of e-portfolio are given below.

... We do not have a very difficult assignment, it is easier than the others, but it still takes a little time because it is within the scope of an assignment (P1).

I was excited because it would be a different way of teaching, but I don't think it has much benefit in the distance education process as in other courses (P5).

By examining the citations, it is understood that it "*takes some time*" to do the activities and the use of an e-portfolio will "*not be beneficial*" in the "*distance education*" process. Accordingly, it can be said that only two of the participants expressed negative thoughts about the process of using an e-portfolio. In addition, while one of the participants had completely negative thoughts, it was understood that the other had negative thoughts along with positive thoughts.

Findings on the relationship between self-efficacy beliefs and academic achievement levels: Correlation analysis was conducted to determine the relationship between the scores obtained from the sub-dimensions of the self-efficacy belief scale of pre-service teachers and the academic achievement test.

The relationship between the sub-dimensions of the scale of self-efficacy beliefs regarding the teaching process and the academic achievement post-test scores is given in Table 6.

Table 6

The Correlation between the Sub-Dimensions of the Self-Efficacy Beliefs of the Pre-service Teachers Regarding Teaching Process and the Academic Achievement Post-Test

	Planning	Implementation	Evaluation	Achievemen posttest
Planning	1	0,83**	0.72**	0.29*
Implementation		1	0.72**	0.23
Evaluation			1	0.24
Self-efficacy total				0.27*
Achievement posttest				1

*p<0.05   **p<0.01

When Table 6 is examined, it is seen that there is a positive and close to middle-level significant relationship between the planning sub-dimension obtained from the self-efficacy beliefs scale of the pre-service elementary teachers regarding the teaching process and their academic achievement post-test scores (r= 0.29, p<0.05). There is a relationship among the sub-dimensions of the self-efficacy beliefs scale related to the teaching process. According to this; a positive and high relationship between planning and implementation (r= 0.83, p<0.01), a positive and high relationship between planning and evaluation (r= 0.72, p<0.01), positive and high relationship between the implementation and evaluation (p=0.72, p<0.01). Among the sub-dimensions of the scale of self-efficacy beliefs regarding the teaching process, there was a positive and non-significant low correlation (r= 0.23, p>0.05) between implementation and academic achievement post-test scores. It is seen that there is a positive and non-significant low correlation (r= 0.24, p>0.05) between evaluation and the academic achievement post-test scores. It is seen that there is a positive, low and significant relationship between the post-test scores obtained from the self-efficacy beliefs scale regarding the teaching process and the academic achievement post-test scores (r= 0.27, p<0.05). Accordingly, it can be said that as the self-efficacy of the pre-service teachers in the group who are exposed to e-portfolio applications in the teaching process increase, their academic success also increases. It is seen that the highest relationship is between the planning and implementation dimensions, and the lowest relationship is between

implementation and academic achievement. Based on these findings, a simple linear regression analysis was performed to reveal the degree of influence of the relationship between the variables in the model, and the results are given in Table 7.

Table 7

Linear Simple Regression Analysis Results for Predicting Academic Achievement

Variable	B	Standard error	Beta	T	p
Constant	52.86	16.57		3.19	0.00*
Self-Efficacy	0.22	0.10	0.27	2.15	0.03*
R=.27	R²=.07				
F(1,59)=4,61	p=.03				

*p<0.05

When Table 7 is examined, it is seen that self-efficacy in the teaching process is a significant predictor of academic achievement (R = .27, R^2 = .07, F (1.59) = 4.610, p<.05). It can be said that 7 % of the total variance regarding self-efficacy for the teaching process is explained by academic achievement. As a result of all these findings, the status of the research hypotheses and research questions are given in Table 8.

Table 8

State of research hypotheses and research questions

	1	2	3	4
Hypothesis	+	+	+	+
Research question	+	+	+	+

According to Table 8, it is understood that positive findings were obtained for all of the research hypotheses and questions.

Discussion

The first of the research hypotheses claim that the use of e-portfolio positively affects pre-service teachers' self-efficacy beliefs. The data obtained within the scope of the "Does the use of e-portfolio cause a significant difference in the self-efficacy beliefs of pre-service elementary teachers' regarding the teaching process?" research question used to prove this hypothesis: It can be said that the self-efficacy beliefs of the pre-service elementary teacher in the control group regarding the teaching process are more positive in terms of self-efficacy beliefs before the research. At the end of the study, a significant difference was found between the experimental and control groups in terms of self-efficacy belief in favor of the experimental group. In other words, it can be said that the self-efficacy beliefs of the pre-service teachers in the experimental group changed positively as a result of the research. In addition, this result was supported by the analysis of the qualitative data of the research. According to this; In the process of using an e-portfolio, it has been determined that there are positive factors on the learning motivation and self-regulation of the pre-service teacher due to factors such as the regularity of the activities, the systematic functioning, the use of technology, and feedback. It can be said that these factors have a positive effect on the development of pre-service teachers' self-efficacy. When all the findings are examined, it is

seen that the first hypothesis of the research was confirmed. As a matter of fact, Ayan (2010) and Meyer et al., (2011) stated in their studies that there was an improvement in teachers' individual abilities such as self-regulation and self-management as a result of using e-portfolios. These findings are similar to the research findings. In addition, in the study of Klecka et al., (2008), e-portfolios were used in the process of forming the identities of teacher educators and defining teacher educators. In addition, Bartlett (2002) stated in his study that the e-portfolio used by pre-service teachers in the process of student evaluation has advantages such as opportunities to use technology, the opportunity to obtain and present information, and evaluation. These data support the findings obtained in the research. Finally, in the study of Gök and et al., (2020), it was determined that the primary school teachers exhibited positive views on the use of portfolios. In addition to all these, similar findings were found in the qualitative findings of the study. Apart from all these data, it was determined in Bahçivan & Aydin (2020) studies that pre-service teachers have high self-efficacy beliefs before starting the profession. Clark (2020) found in his study that the self-efficacy beliefs of pre-service teachers also decreased a little after they started to work.

The second of the research hypotheses claim that the use of e-portfolio positively affects the academic achievement of pre-service teachers. The data obtained within the scope of the " Does the use of e-portfolio cause a significant difference in the academic achievement levels of pre-service elementary teachers'?" research question used to prove this hypothesis: While there was no difference between the experimental and control groups in terms of academic achievement before the research, it was determined that the academic achievement of the experimental group pre-service teacher changed positively as a result of the research. Likewise, it can be said that in the process of using qualitative findings, pre-service teachers have achieved success in PPSE trials, which are an indicator of their academic achievement, as they see different questions with different activities, make repetitions, and receive immediate feedback with usage e-portfolio. These findings confirm the second hypothesis of the study. Similarly, in the studies of Ayaz et al., (2020), it was determined that the use of e-portfolios of eighth-grade students had a positive effect on their academic achievement. In addition, Zeybek (2019) determined that the academic achievement of high school students changed positively as a result of their use of e-portfolio. In addition, Akgün & Şahin Kölemen (2020) found that the academic skills of associate degree students using e-portfolio activities improved positively. These findings are similar to the research findings. In addition to these studies, Painter & Wetzel (2005) and Strawhecker et al., (2007) determined that pre-service teachers' success in getting a job is easier as a result of using an e-portfolio. In addition, in the study of Shepherd & Hannafin (2008), it is known that as a result of using an e-portfolio, it helps pre-service teachers to evaluate and change their perceptions of success, examine student behavior more deeply, and to guide the decision-making process. The similarity to the qualitative findings of the research, Çukurbaşı & Kıyıcı (2018) found that primary school teachers had positive views on their portfolio use.

The third hypothesis of the research claimed that the pre-service teachers had positive opinions about the effect of using e-portfolio in the teaching process on their self-efficacy beliefs and academic achievement. The data obtained within the scope of the "What are the views of pre-service teachers' on the effect of using e-portfolio in the teaching process on self-efficacy beliefs and academic achievement?" research question used to prove this hypothesis: Accordingly, pre-service teachers think that the use of e-portfolio in the teaching process has a positive effect on self-efficacy and academic achievement. Similarly, many research findings in the literature have determined that the use of e-portfolios in the teaching process has a positive effect on academic achievement and self-efficacy (Bartlett, 2002; Kloser et al., 2020; Shepherd & Hannafin, 2008).

The fourth hypotheses claim that there is a linear relationship between pre-service teachers' self-efficacy beliefs and their academic achievement. The data obtained within the scope of the "What is the relationship between pre-service teachers' self-efficacy beliefs and their academic achievement levels?" research question used to prove this hypothesis: It was determined that the self-efficacy belief increased in the experimental group in which the e-portfolio application was used, which positively affected academic achievement. These findings confirm the third hypothesis of the study. It is known that as a result of the e-portfolio application, it affects the development of high-level mental skills of the participants (Ayan & Seferoğlu, 2011; Meyer et al., 2013; Polat Demir & Kutlu, 2016). As a result of the use of e-portfolio in the research process, the development of pre-service teachers' self-efficacy beliefs and their academic achievement can be considered

high-level mental skills. In addition, similar to the research finding, Czocher et al., (2020) determined in their study that students' self-efficacy levels were effective in achieving more gains. In addition, Kloser et al., (2020) showed that the use of e-portfolios can be important tools for teachers to think.

Conclusion and Recommendations

It was determined that the use of e-portfolio positively affected the self-efficacy beliefs of pre-service teachers. Accordingly, it was determined that there was an increase in the self-efficacy beliefs of the pre-service teachers as a result of their use of e-portfolio. It can be suggested that technology-integrated applications such as e-portfolio can be used to increase self-efficacy beliefs. Self-efficacy beliefs of pre-service teachers as a result of their use of e-portfolio in all educational processes are also a matter of curiosity.

It has been determined that the use of e-portfolio positively affects the academic achievement of pre-service teachers. Based on these findings, it was determined that the academic achievement of the pre-service teacher increased as a result of their use of e-portfolio. E-portfolio applications are recommended in order to achieve success in the preparation of pre-service teachers for central exams, especially in assessment and evaluation. The use of e-portfolio can be recommended to increase or determine the success of students at different grade levels (middle school or high school) in central exams.

As a result of the research, it was determined that the pre-service teachers thought that the use of e-portfolio in the teaching process had a positive effect on their self-efficacy belief and academic achievement. This result has a positive effect on the necessity of using e-portfolio in teaching processes.

A linear relationship was found between pre-service teachers' self-efficacy beliefs and their academic achievement. Accordingly, a positive, significant, and positive relationship was determined between the self-efficacy beliefs and academic achievement status of the experimental group pre-services teacher as a result of their e-portfolio use. In the studies aimed at increasing the academic achievement of pre-service teachers in the education-teaching process, it is recommended to first determine the self-efficacy beliefs and keep them high. It is thought that many positive developments will be experienced in different aspects as a result of the development of self-efficacy of students or pre-service teachers in the education process.

As a result of the research; it can be said that all of the research hypotheses have been proven and thus the answers to the research questions have been determined. In light of these findings, it has been determined that the e-portfolio can be used in the teaching process and has a positive effect on academic achievement with self-efficacy belief.

Some suggestions for future research on e-portfolios and points for repeaters to consider include. More attention needs to be paid to data privacy and security issues related to the use of electronic portfolios. Research should address issues such as how to protect student data, the effectiveness of authorization processes, and the applicability of data security measures. The social and egalitarian dimensions of electronic portfolios should be further explored. Research should examine whether e-portfolios provide equal access and opportunities among different student groups, the effects of the digital divide, and the impact of socioeconomic factors on e-portfolio use.

If other researchers want to do a similar study, it is recommended to pay attention to the following points. Participant selection in the study should be done carefully. Researchers should select an appropriate group of participants, taking into account the characteristics of the participants (age, gender, education level, etc.) and their experience in using the e-portfolio. Research can be conducted on how e-portfolios can be integrated into learning processes and how they can be effective in areas such as students' learning motivation, self-efficacy, and creative thinking. It can also be explored how teachers can use e-portfolios for student assessment and teaching strategies. Research can be conducted on how e-portfolios can be used in different disciplines and how they are effective at various educational levels. For example, it can be examined how e-portfolios can be used in areas such as STEM education, arts, language learning, or vocational training.

Limitations of the study

      This study is limited to 61 pre-service teachers and 14 weeks. It is assumed that participants present objective data. Actually, all information about the participants was presented to make this situation feel strong. It was assumed that the participants' internet access and computer use skills were equivalent during the 14-week period. In the research, the effect of e-portfolio application on self-efficacy and academic achievement was examined. The research is limited to e-portfolio, self-efficacy, and academic achievement factors. Other factors than these have not been examined. The hypotheses used in the research are one-way hypotheses prepared and integrated into positive results. The negative aspects of these hypotheses can also be addressed, but they are not taken into account as they are proven by the findings. E-portfolio is an important technical support for data protection and storage in the online education process, which is an alternative education approach. The biggest concern we have here is that all students do not have equal access to the internet, having a computer, phone or tablet, and infrastructure adequacy.

Compliance with Ethical Standards

Disclosure Statement

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      All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. On behalf of all authors, the corresponding author states that there is no conflict of interest.

Informed Consent

      Informed consent was obtained from all individual participants included in the research.

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