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Research Article

An Investigation of Digital Teaching Material Design Proficiency Levels in Terms of Various Variables

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Abstract – This research aims to examine pre-service science teachers' self-efficacy in developing digital teaching materials with web 2.0 tools according to various variables. The study was conducted by the quantitative research method and the survey model was utilized. The sample of the study consists of 450 pre-service science teachers studying at three different state universities in Turkey. Data were collected through the "Self-Efficacy Scale of Teachers' Digital Teaching Material Development." While analyzing the data; descriptive statistics, t-tests, and analysis of variance tests were used. According to the findings, the pre-service science teachers' self-efficacy in developing digital materials with Web 2 tools differed significantly according to their university, year of university education, and previous content development with Web 2.0. However, no significant differentiation was observed according to their gender. In light of all these results, it was found that pre-service teachers' proficiency in producing digital material using Web 2.0 is at a moderate level and differed significantly according to various variables.

Keywords: digital material, self-efficacy, web 2.0, pre-service teacher, science education

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Introduction

With the COVID-19 pandemic that appeared in December 2019, the importance of technology in education has increased. Teachers began to teach lessons through distance education and the online education system began to be used instead of face-to-face education.

In this period, the role of digital materials in education has gained more importance. Along with the use of digital teaching materials in the COVID-19 period, teachers' use of digital articles in the area being addressed should be reviewed. Such articles must be referenced accurately.

technology in teaching and their digital skills have improved. Their ability to use digital technologies has increased (Beardsley et al. 2021).

Teachers' self-efficacy level has significant importance on their ability to teach. A high sense of self-efficacy allows them to have positive teaching approaches and positive behaviors (Tavyl, 2014). Saavedra and Opfer (2012) stated that the nine principles that 21st-century teachers should pay attention to in setting up the learning environment are developing thinking skills, teaching-learning, teaching through science, associating concepts and subjects, showing mistakes, supporting the learning process with technology, directing teamwork, promoting knowledge transfer and improving productivity.

According to the standards of the International Society for Technology in Education (ISTE), the 21st-century teacher should have the roles of a leader, a collaborator, a designer, a citizen, an analyst, and a facilitator (ISTE, 2021). Teachers, who also assume the role of designers of education, need to consciously plan the use of technology to reinforce students' learning (McLeod, 2018). In this context, it can be said that the designer role of teachers is necessary for education. It can be thought that creating and designing content using Web 2.0 software will also contribute to the competencies of the teachers.

The Technological Pedagogical Content Knowledge (TPACK)

Technological pedagogical content knowledge (TPACK) is a structure based on the interaction of pedagogical and technological knowledge. Teachers should understand technology knowledge enough to use it in their workplaces and their daily lives and should know in which situation technology knowledge will help to reach the goal. In this sense, according to the TPACK view, technology knowledge encompasses a broader meaning (Mishra & Koehler, 2008). Öztürk et al. (2020) found that pre-service teachers' cognitive flexibility and techno-pedagogical education competencies were at a high level in their study. At the same time, it was found that techno-pedagogical competency did not differ significantly according to program type and gender but showed a significant difference according to the variables of having a computer and internet. Durusoy and Karamete (2023) used the Learning by Design (LBD) framework to develop pre-service teachers' TPACK

competencies. According to the results, there was a significant increase in pre-service teachers' TPACK competence levels as a result of the training provided with this framework.

Tatli et al. (2016) found a significant increase in the TPACK levels of teachers using Web 2.0 tools in their study. Choo et al. (2020) found a positive relationship between teachers' Web 2.0 self-efficacy and the level of integration of Web 2.0 tools into science lessons. In addition, Wright and Akgunduz (2018) found a positive relationship between TPACK self-efficacy beliefs and Web 2.0 content development. In addition, Öztürk et al. (2022) found that web 2.0 workshops improved pre-service teachers' techno-pedagogical competencies. The pre-service teachers were satisfied with the workshop.

Studies are showing a relationship between Web 2.0 self-efficacy and TPACK (Kul et al. 2019). In this study, the development of digital materials by pre-service teachers using Web 2.0 tools, one of the popular digital technologies of today, is examined. In this sense, the TPACK knowledge that teachers will gain can be associated with Web 2.0 usage and competencies. In this research, it is thought that determining the competencies of teachers in terms of the techno-pedagogical content approach is important in this regard.

Web 2.0 in Science Education

The use of digital materials has a key place in technology-supported education. While digital materials refer to the use of different media and resources such as internet resources, projectors, and computers and to present them through an electronic environment, non-digital materials refer to materials prepared with tools such as newspapers, paper, pens, money, beads, beans, and scissors (Howell & O'Donnell, 2017). One of the digital materials used within the scope of technology-supported education is the applications prepared with Web 2.0 tools.

The Web 2.0 trend has emerged as a current way of perceiving the internet in our age, and this has increased the influence of people involved in creating, sharing, promoting, and uploading several types of data (Krajka, 2012). One of the notable features of these Web 2.0 technologies is that they allow users to intervene and contribute to the content of web pages in line with the authorizations given to them without the need for technical knowledge (Karaca & Aktaş, 2019).

Web 2.0 tools create a suitable educational environment when used in a student-centered manner. For example, it is appropriate for a student-centered education for students

to write their comments and interact on a board created by the teacher on the Padlet. Or students can express their opinions on a blog. It can be said that the use of Web 2.0 applications in a student-centered and collaborative manner to develop students' problem-solving skills is quite beneficial. There are studies in the literature that support this idea. Research (Ravenscroft et al. 2013) shows that Web 2.0 technology supports active and collaborative learning of students and creates a student-centered environment. Web 2.0 technologies enhance collaboration and communication skills. With this technology, students can construct information and create a common product. In addition, this technology increases students' digital literacy levels (Magnuson,2013). Koehler et al. (2017) researched problem-solving-supported education. According to the results, it was found that web 2.0 tools played a role in facilitating learning and were effective in students' collaboration in problem-solving-supported education.

According to the other research results, it was found that Web 2.0-supported concept cartoons caused significant changes in students' attitudes and achievements (Gürleroglu,2019; Can & Usta, 2021). Yildirim and Gurleroglu (2022) examined the use of Web 2.0 in the "Force and Energy" unit during the pandemic process. They found that Web 2.0 tools positively affected the achievement and motivation of seventh-grade students. Cin Seker (2020), in his study with fifth-grade students, found that the Plickers application caused a significant difference in the academic success of the students.

Efficacy of Use Web 2.0

Web 2.0 tools led to significant differences in the achievement and attitudes of pre-service science teachers also. For example, according to a result of Korucu et al. (2020) research, the use of Web 2.0 technologies has increased the questioning skills and academic success of biology teacher candidates. In addition, these tools facilitate learning, improve collaboration, and make the lesson fun.

Habibi et al. (2020), examined the integration of digital materials by 217 Science teachers in Indonesia. It has been revealed that teachers' attitudes have a high impact on their level of integration and there is no significant difference in terms of integration according to their gender. In a study, the web 2.0 competencies of 217 science teachers were examined by demographic information. According to the results, there is no significant difference in their experience and gender. A significant difference was found by age (Dollah & Mahmud,2022). Kul et al. (2022) examined the content development competencies of 336 pre-service teachers with Web 2.0. According to the results, it has been determined that pre-service teachers'

information and communications technology competencies influence the development of their Web 2.0 self-efficacy.

Teachers' Self-efficacy

Teachers' self-efficacy level has significant importance on their ability to teach (Tavyl, 2014). Low self-efficacy and beliefs of teachers were defined as factors that hinder technology integration (Xiaobin et al. 2014; Tsai and Chai,2012). We think that pre-service teachers' preparation of technological content is worth investigating in terms of guiding the future of today's technology-supported education. Although studies on this subject have increased recently, we believe that there are not enough studies on the digital competencies of teachers.

Although there are similar scales measuring Web 2.0 self-efficacy in the literature, it was seen that the scale used in the study was used only once before but was applied to teachers. In addition, research was not conducted to include all variables in this study. This research aims to aid in filling that gap in the literature. Technology will become more widespread in education in the future, and the importance of a teacher's use of technology in the classroom is increasing. For this reason, we emphasize the importance of special research on teacher candidates' ability to integrate the technology they will use in their professional lives into their classrooms and prepare materials accordingly.

This research aimed to determine the self-efficacy of pre-service science teachers in developing digital teaching materials with Web 2.0 tools and to examine them according to their university, gender, year of university education, and previous content development with Web 2.0. To achieve this aim, the self-efficacy levels of the pre-service teachers were measured, and answers were sought to the following research question:

Is there a significant difference in the self-efficacy of pre-service science teachers in developing digital teaching materials with Web 2.0 tools in terms of their university, gender, year of university education, and previous content development with Web 2.0?

The sub-questions are as follows:

1. What is the digital teaching material proficiency of science pre-service science teachers?

2. Do pre-service science teachers' self-efficacy in developing digital teaching materials show a significant difference according to gender?

3. Do pre-service science teachers' self-efficacy in developing digital teaching materials differ significantly according to the university they attend?

4. Do pre-service science teachers' self-efficacy in developing digital teaching materials show a significant difference according to their year of university education?

5. Do pre-service science teachers' self-efficacy in developing digital teaching materials show a significant difference depending on whether they have previously developed course content with Web 2.0 software or not?

Method

Research Design

The study was conducted by the quantitative research method and the survey model was utilized. Survey models have three key features (Frankel & Wallen, 2009):

1. Characteristics or views belonging to a community are defined. The sample is suitable for the research is determined.

2. The answers given by the group members, who are the data sources, form the research data.

3. Data are collected from a representative sample of the population, not from the entire population.

Participants

The sample of the research consists of 450 pre-service science teachers studying in the Science Teacher Education Program in the Marmara Region in the 2020-2021 Spring semester. The distribution table of the pre-service teachers participating in the study by gender and the university they attended is given in Table 1:

Table 1 Distribution of Pre-Service Science Teachers Participating in The Study by Gender and University of Education

		Gender		
		Female	**Male**	**Total**
University	A	17	206	223
	B	13	110	123
	C	16	88	104
Total		46	404	450

Data collection

The scale was conveyed to the pre-service science teachers through the chat section during the online lectures held in Google Meetings and Zoom environments. The participants answered the questions on the scale within the time given to them.

Teachers' Digital Teaching Material Development Self-Efficacy Scale: This scale developed by Korkmaz et al. (2019) was used as a data collection tool in the research. Reliability analyses of the scale were performed by Korkmaz et al. (2019). The Cronbach Alpha reliability coefficient was found to be 0.961 by the researcher. The 5-Point Likert Scale consists of three factors and 38 items. The scale structure consists of 14 items constituting the "Web 2.0 Development" factor, 18 items constituting the "Design" factor, and six items constituting the "Negative Opinion" factor (Korkmaz et al. 2019). Korkmaz et al. (2019) determined that the scale is valid and safe because of their analysis.

Data Analysis

The collected quantitative data were analyzed with the SPPS 25 program. Variables in the scale were entered into the SPSS program for statistical analysis. Demographic information of pre-service science teachers was also added as a variable. The answers given by the pre-service teachers on the Likert-type scale were entered into the SPSS program as 1, 2, 3, 4, and 5, and variables such as gender, class, and university were entered into the system separately for each participant.

Missing and incorrect ones from the collected data were not included in the data set. The remaining data were entered into the program. When the data entry was completed, the average and standard deviation values of each sub-dimension of the scale were calculated. Skewness and Kurtosis values were considered for normality analyses. Since the Skewness and Kurtosis values varied between -2 and +2, it was decided that the distribution of all data was normal. Data analyses were performed using the One-Way Analysis of Variance (ANOVA) test and Independent Sample t-test (George & Mallery, 2010). The homogeneity of the variances was checked with the help of Levene's test. The level of homogeneity was found suitable for the ANOVA test. The Cronbach Alpha value was found 0.95 by the researcher. KMO and Bartlett's analyses were performed. The KMO value was found above 0.60. If the Cronbach Alpha value is 0.70 and above, it is considered appropriate in terms of reliability (Büyüköztürk, 2002).

Validity and reliability

The scale used in research developed by Korkmaz et al. (2019) was used as a data collection tool in the research. Reliability analyses of the scale were performed by Korkmaz et al. (2019). The Cronbach Alpha reliability coefficient was found to be 0.961 by the researcher. Korkmaz et al. (2019) determined that the scale is valid and safe because of their analysis. In this study, the Cronbach Alpha reliability coefficient was found to be 0.95.

Results and Discussions

Results

Results of the first sub-problem

A scale consisting of 38 items was applied to the pre-service science teachers who wanted to determine their digital material development self-proficiency. The data obtained were analyzed. To provide answers to the first question, standard deviation results, and the arithmetic mean were examined. The findings of digital material development self-proficiency levels according to the answers given by the pre-service science teachers are presented in Table 2:

Table 2 Descriptive Analyses of The Scores of Pre-Service Science Teachers From Digital Material Development Self-Sufficiency Scale By Dimensions

Dimensions	n	Minimum	Maximum	x̄	SD
Web 2.0 development	450	1.00	5.00	3.39	1.05
Design	450	1.00	5.00	3.80	1.07
Negative gaze	450	1.00	5.00	2.65	.89
Total	450	1.45	4.84	3.47	.73

Note. N = number of participants; x̄ = mean; SD = standard deviation

When Table 2 is examined, it is seen that the minimum value of the total self-proficiency scores of the pre-service science teachers is 1.45 and the maximum value is 4.84. The total average self-proficiency score of pre-service science teachers is 3.47. The highest average score was in the Design subdivision (x̄= 3.80, SD=1.07). After the design subdivision comes points from the Web 2.0 development subdivision (x̄= 3.39, SD= 1.05). The lowest average score belongs to the negative opinion subdivision (x̄= 2.65, SD= 0.89).

Results of the second sub-problem

To determine whether the pre-service teachers' self-efficacy in developing digital teaching materials differed significantly by gender, analyses were made with the Independent Samples t-test. Analysis results are given in Table 3.

Table 3 T-Test Analysis Results of Pre-Service Science Teachers' Digital Material Development Self-Efficacy by Gender

Dimensions	**Gender**	**n**	**x̄**	**SD**	**df**	**t**	**p**
Web 2.0 Development	Female	46	3.41	1.05	448	.961	.337
	Male	404	3.25	1.05			
Design	Female	404	3.80	1.07	448	.277	.782
	Male	46	3.76	1.06			
Negative gaze	Female	404	2.65	.89	448	.196	.845
	Male	46	2.62	.97			
Total	Female	404	3.47	.74	448	.734	.463
	Male	46	3.39	.70			

Note. N = number of participants; x̄ = mean; SD = standard deviation; df = degree of freedom

According to the findings in Table 3, no significant difference was found in the level of self-efficacy between male and female pre-service teachers participating in the study ($p>0.05$). In addition to the absence of a significant difference, the self-efficacy score average of female pre-service teachers ($\bar{x}= 3.47$, SD: 0.74) is higher than the self-efficacy scores of male pre-service teachers ($\bar{x}= 3.39$, SD: 0.70).

Results of the third sub-problem

In digital material development, an ANOVA test was applied to determine whether the self-sufficiency of the pre-service science teachers showed meaningful differentiation compared to the university at which they studied. The results of the analysis are indicated in Table 4 and Table 5.

Table 4 Results of ANOVA Test Analysis results of Digital Material Development Self-Proficiency of Science Pre-service science teachers according to the University Where They Study

Dimensions	Source of variance	Sum of squares	SD	Mean squares	F	p	Significant difference	η^2
Web 2.0 development	In groups	16.134	2	8067	.7478	.001	B>A, B>C	.967
	Between groups	482.244	447	1079				
	Total	498.379	449					
Design	In groups	8.838	2	4419	3.857	.022	B>A, B>C	.983
	Between groups	512.150	447	1146				
	Total	520.988	449					
Negative gaze	In groups	2193	2	1096	1.358	.258		
	Between groups	360,843	447	.807				
	Total	363,035	449					
Total	In groups	7092	2	3546	6.665	.001	B>A, B>C	.971
	Between groups	237,846	447	.532				
	Total	244,939	449					

Note. SD = standard deviation; η2=effect size

In Table 4, the ANOVA test was applied to determine whether there was a significant difference for universities according to the answers given by the pre-service science teachers at different universities. When the findings were examined together with the findings in Table 5, it was determined that there was a significant difference between the design, web 2.0 development dimensions, and total self-proficiency scores of the pre-service science teachers compared to the universities ($p < 0.05$).

According to the universities, variance analyses were applied to examine self-sufficiency. It was concluded that the variances were distributed homogeneously because the sig>0.05 in the lower dimensions and total scores of the scale. It has been determined that there is a significant difference. Tukey post-hoc tests were performed to determine which universities made this difference.

Descriptive statistics were also used to determine which universities differed in favor of the difference, i.e., the direction of the difference. Standard deviation and average values were looked at. The illustrative statistics are presented in Table 5.

First, self-proficiency findings in the web 2.0 development subdivision were examined. It was determined that there was a significant difference between University B scores ($\bar{x}$= 3.69, SD=1.05) and University C score ($\bar{x}$= 3.20, SD=1.00) in favor of University B, and a significant difference between University B score ($\bar{x}$= 3.69, SD=1.05) and University A score ($\bar{x}$= 3.31, SD=1.04) again, in favor of University B ($p<0.05$). The effect size was calculated as 0.967. It shows that university has a "large effect" on teachers' web 2.0 development efficacy.

The findings of the design subdivision were also examined. As a result of the tests, it was determined that there was a significant difference between University B scores ($\bar{x}$= 4.02, SD:0.94) and University C scores ($\bar{x}$= 3.67, SD:1.08) in favor of University B, and a significant difference between University B score ($\bar{x}$= 4.02, SD:0.94) and University A score ($\bar{x}$= 3.73, SD:1.12) again, in favor of University B ($p<0.05$). The effect size was calculated as 0.983. It shows that university has a "large effect" on teachers' designing material efficacy. Looking at the total scores, the digital material development self-proficiency scores of pre-service science teachers studying at University B ($\bar{x}$= 3.67, SD:0.69) are significantly higher than pre-service science teachers studying at University C ($\bar{x}$= 3.34, SD:0.74) and University A ($\bar{x}$= 3.41, SD:0.74, $p<0.05$). The effect size was calculated as 0.971. There was no significant difference in negative view subdivision scores that were outside of these two subdivisions ($p>0.05$).

Table 5 Visual Statistical Results of Science Pre-service Science Teachers' Self-Proficiency in Digital Material Development by University

Dimensions	**University**	**n**	**$\bar{x}$**	**SD**
Web 2.0 development	A	223	3.31	1.04
	B	123	3.69	1.05
	C	104	3.20	1.00
Design	A	223	3.73	1.12
	B	123	4.02	.94
	C	104	3.67	1.08
Negative gaze	A	223	2.69	.91
	B	123	2.53	.91
	C	104	2.68	.83
Total	A	223	3.41	.74
	B	123	3.67	.69
	C	104	3.34	.74

Note. N = number of participants; $\bar{x}$ = mean; SD = standard deviation

Results of the fourth sub-problem

To determine whether the pre-service teachers' self-efficacy in developing digital instructional material differs significantly according to the class that they are studying, analyses were made with the ANOVA test. Analysis results are given in Table 6 and Table 7.

Table 6 Results of ANOVA test analysis of digital material development self-efficacy of pre-service science teachers by year of university education.

Dimensions	Source of variance	Sum of squares	SD	Mean squares	F	p	Significant difference	η2
Web 2.0 development	In groups	38.447	3	12.816	12.427	.000	3>1, 2>1	.922
	Between groups	459.932	446	1031				
	Total	498.379	449					
Design	In groups	13.560	3	4520	3.973	.008	3>1, 2>1	.973
	Between groups	507.428	446	1138				
	Total	520.988	449					
Negative gaze	In groups	7.419	3	2473	3102	.027	3>1, 2>1	.979
	Between groups	355.616	446	.797				
	Total	363.035	449					
Total	In groups	12.385	3	4.128	7917	.000	3>1, 2>1	.949
	Between groups	232.554	446	.521				
	Total	244.939	449					

Note. SD = standard deviation; η2=effect size

In Table 6, an ANOVA test was conducted to determine whether there was a significant difference in terms of years of university education according to the answers given by pre-service teachers. The obtained findings were analyzed together with the findings in Table 7. As a result, it was determined that there were significant differences in Web 2.0 Development, Design, and Negative Gaze sub-dimensions ($p<0.05$).

Analysis of variance was conducted to examine self-efficacy according to participants' years of university education. It was determined that the total scores and sub-dimensions of the scale were sig>0.05, and it was observed that the variances were homogeneously distributed. Therefore, in this case, where there was a significant difference, Tukey posthoc tests were performed to determine between which grades the difference was. Descriptive statistics were also used to determine which year of university education was in favor. While performing the analysis, the mean and standard deviation values were checked. Descriptive statistics of the results are presented in Table 7.

As a result, there was a significant difference in total scores and all sub-dimension scores. These dimensions are Web 2.0 Development, Design, and Negative Opinion sub-dimensions.

First, Web 2.0 development self-efficacy findings were examined. Related tests were applied. There was a significant difference between first-year pre-service science teachers' score ($\bar{x}$= 2.91, SD: 0.99) and third year pre-service science teachers' score ($\bar{x}$= 3.69, SD: 1.09) in favor of third year pre-service science teachers, and a significant difference between first-year pre-service science teachers' score ($\bar{x}$= 2.91, SD: 0.99) and second year pre-service science teachers' score in favor of the second year pre-service science teachers between the

scores ($\bar{x}$= 3.58, SD: 0.94, p <0.05). The effect size was calculated as 0. 922. It shows that grade has a "large effect" on a teacher's web 2.0 development efficacy. Statistics in the Design sub-dimension, which is the other dimension where significant differentiation occurs, were examined. Related tests were applied. There was a significant difference between first-year pre-service science teachers' score ($\bar{x}$= 3.54, SD: 1.02) and third year pre-service science teachers' score ($\bar{x}$= 3.87, SD: 1.17) in favor of first-year pre-service science teachers', and a significant difference between first-year pre-service science teachers' score ($\bar{x}$= 3.54, SD: 1.02) and second year pre-service science teachers' score ($\bar{x}$= 4.01, SD: 0.85) in favor of the second year pre-service science teachers (p< 0.05). The effect size was calculated as 0.973. It shows that university has a "large effect" on teachers' designing material efficacy.

A significant difference was also found in the Negative Opinion sub-dimension. In the Negative Opinion dimension, there was a significant difference between the first-year pre-service science teachers' score ($\bar{x}$= 2.86, SD: 0.80) and the third year pre-service science teachers' score ($\bar{x}$= 2.50, SD: 1.00) in favor of the third year pre-service science teachers and a significant difference between the first-year pre-service science teachers' score ($\bar{x}$= 2.86, SD: 0.80) and second year pre-service science teachers' scores ($\bar{x}$= 2.59, SD: 0.79) in favor of the second year pre-service science teachers (p <0.05). The effect size was calculated as 0.979.

Table 7 Visual Statistical Results of Science Pre-service Science Teachers' Self-Proficiency in Digital Material Development by Year of University Education

Dimensions	**Year of University Education**	**n**	**$\bar{x}$**	**SD**
Web 2.0 development	Firs year	105	2.91	.99
	Second year	125	3.58	.94
	Third year	103	3.69	1.09
	Fourth year	117	3.36	1.03
Design	Firs year	105	3.54	1.02
	Second year	125	4.01	.85
	Third year	103	3.87	1.17
	Fourth year	117	3.74	1.19
Negative gaze	Firs year	105	2.86	.80
	Second year	125	2.59	.79
	Third year	103	2.50	1.00
	Fourth year	117	2.65	.96
Total	Firs year	105	3.20	.66
	Second year	125	3.63	.59
	Third year	103	3.59	.82
	Fourth year	117	3.43	.79

Note. N = number of participants; $\bar{x}$ = mean; SD = standard deviation

Results of the fifth sub-problem

To determine whether the self-efficacy of pre-service science teachers studying in the Science Teaching Program in digital material development showed a significant difference compared to the pre-service science teachers' creating course content with Web 2.0, analyses were made with the Independent Samples t-test. Analysis results are given in Table 8:

Table 8 t-Test Results of Pre-Service Science Teachers' Self-Efficacy in Digital Material Development According to The Variable of Content Development With Web 2.0 Previously

Dimensions	Content	n	x̄	SD	df	t	p	η2
Web 2 development	Yes	275	3.73	.95	448	9.511	.000	.922
	No	175	2.85	.96				
Design	Yes	275	3.98	1.08	448	4.700	.000	.449
	No	175	3.51	.99				
Negative gaze	Yes	275	2.46	.91	448	-5.730	.000	.556
	No	175	2.94	.78				
Total	Yes	275	3.65	.74	448	7.023	.000	.689
	No	175	3.17	.62				

Note. N = number of participants; x̄ = mean; SD = standard deviation; df = degree of freedom

According to the independent t-test result, there was a significant difference between those who had previously developed course content with Web 2.0 and those who did not ($p<0.05$) Self-efficacy scores of those who had previously developed course content with Web 2.0 ($\bar{x}= 3.65$, SD: 0.74) were higher than those who had not developed it before ($\bar{x}= 3.17$, SD: 0.62). The effect size of the scale was calculated as 0.689. It shows that teachers' creating course content with Web 2.0 has a "large effect" on teacher's development material efficacy.

Discussion

With the COVID-19 pandemic that emerged in December 2019, the importance of technology in education has increased. Teachers started to teach via distance education, and the online education system began to be used instead of face-to-face education. With this situation, the necessity of using digital materials used by teachers during face-to-face education has also emerged in the online environment (König et al., 2020). It would be appropriate to use Web 2.0 tools for this purpose.

The widely adopted teacher-centered view of education may change under the lead of Web 2.0 technology (Butler, 2012). In research, it was found that Web 2.0 technologies are versatile technology that provides services for pedagogical purposes (Coutinho, 2008).

This study, it was aimed to find pre-service science teachers' sufficiency in digital material development with Web 2.0 tools according to various variables. The result of this research indicates that pre-service science teachers' digital material development self-efficacy is moderate. The highest mean score was experienced in the Design sub-dimension. Based on the findings, it can be said that pre-service teachers consider themselves more competent in design compared to the Web 2.0 development sub-dimension. After the design sub-dimension, the scores from the Web 2.0 development sub-dimension are up next. The lowest mean score belongs to the negative opinion sub-dimension. It can be said that pre-service science teachers do not have a negative view of developing digital materials in general.

It may be useful to examine the reasons for this result. It may be caused by the environment of the pre-service teachers or by their internal factors. Supporting this, teachers' self-efficacy is effective in using technology in their classrooms (Inan & Lowther, 2010). In other words, pre-service teachers' use of technology increases their self-efficacy; It can be said that those with high self-efficacy tend to use it more. Moreover, a meaningful relationship was found between teachers' computer self-efficacy and their ability to develop online assessment material. Teachers' digital efficacy is a positive indicator for their development of online assessment materials (Ninković et al. 2021).

According to Bandura (1977), self-efficacy is related to the self-efficacy level of the person before the action is taken. In other words, it can be thought that it is necessary to analyze the formation process of self-efficacy well. In this process, it can be said that the school of education also influences proficiency. A similar result was found in this study. According to the results, there was a significant difference between universities.

It was seen that the digital material development self-efficacy of pre-service science teachers shows a significant difference according to the university they study at. It was determined that the scores of pre-service teachers in Web 2.0 Development and Design dimensions and their total self-efficacy scores differed significantly according to universities. The pre-service teachers at B universities are more competent than the pre-service teachers at A and C Universities in developing and designing digital materials using Web 2.0. studies that measure digital material development self-efficacy according to universities were not encountered during the literature review. Some studies measure technological competencies according to the type of high school graduate. Tekerek et al. (2012) selected pre-service teachers from the Department of CEIT as a sample in their study. They measured computer

self-efficacy. There was a significant difference in favor of vocational high school graduates according to the type of secondary education graduated from. Likewise, it has been revealed that individuals who have previously used Web 2.0 are more confident in developing materials.

It was determined that the digital material development self-efficacy of pre-service science teachers shows a remarkable difference compared to their previous development of course content with Web 2.0. A significant difference was found among the prospective teachers who participated in the study in favor of those who previously developed course content with Web 2.0. Pre-service teachers who have previously developed course content using Web 2.0 software consider themselves more competent than those who have not developed it before. This result can be said to be effective in the fact that these pre-service teachers gain knowledge and experience in material development and design while developing course content with Web 2.0. A similar result was found by Alhassan (2017).

Similarly, Caner and Aydin (2021), in their study, found that Science and Foreign Language preservice teachers' digital self-efficacy score was above average. Akkoyunlu and Soylu (2010), in their study, found that teachers' digital technology competencies were moderate; When compared in terms of sub-dimensions, it was determined that their awareness and motivation were high, and their competence and technical access levels were moderate.

Unlike this result, Pan and Franklin (2011) found in their study that teachers have low self-efficacy in using Web 2.0 tools and they integrate Web 2.0 tools into their lessons with low frequency. Lei's (2009) findings verified that teachers are not ready to integrate Web 2.0 tools into their classrooms. The researchers also have confirmed that many teachers felt anxious about the integration, despite knowing the benefits of integrating Web 2.0 technologies into their teaching (Chen and Jang, 2014; Hew & Cheung, 2013).

It was seen that the digital material development self-proficiency of pre-service science teachers does not show any significant difference by gender. In addition to the similarity scores of male and female pre-service teachers, female pre-service teachers have higher digital material self-proficiency than male pre-service teachers. There was no significant difference in web 2.0 development, design, and negative opinion sub-dimensions. Similar results were found by researchers (Gökbulut et al.2021; Habibi et al.,2020; Kreijns et al. 2013; Say & Yildirim, 2020). Unlike this result, there was significant differences were found by researchers (Hao & Lee, 2015; Ocak & Karakuş, 2019; Sağlam, 2007; Yılmaz et al., 2015).

It was determined that the digital material development self-efficacy of pre-service science teachers shows a significant difference according to their years of university education. Second and third year pre-service science teachers' have a better level of self-efficacy in digital material development than first-year pre-service science teachers. It can be thought that the fact that the first-year pre-service science teachers have not yet completed the computer course in the undergraduate curriculum and that they have just started university can be the biggest factors in determining this result. Similarly, studies were conducted in which there were significant differences according to year of university education (Eser, 2020; Kozan & Özek,2019).

Yılmaz et al. (2015) conducted a study to determine the perceptions of primary school pre-service teachers about determining computer proficiency and using technology in education. There was no significant difference in terms of technology use and computer proficiency according to year of university education. Unlike this result, it was determined that there was a significant difference between participants' years of university education in this research.

Conclusions and Suggestions

In light of all these results, it can be said that the pre-service teachers' proficiency in producing digital material using Web 2.0 is at a moderate level. Content production with technological applications is a critical issue in teacher education. The fact that we live in the age of technology also requires having a certain technological competence. Teachers need to have a quality education process in Education Faculties. According to the information extracted from this study, it is recommended that the course contents be designed in a way that will improve pre-service teachers' self-confidence in producing digital materials. The material development course using Web 2.0 technology should be added to the curriculum of the Faculties of Education as an elective course or compulsory course by educational policymakers. In the teaching practice courses, qualified training can be given on the integration of Web 2.0 software into the Science course, which will contribute to the professional development of pre-service teachers. Besides, educational policymakers can take advantage of this study since the results can promote see teachers' self-efficacy. Moreover, teachers' Web 2.0 competencies should be modeled with academic studies and their reflections should be analyzed comprehensively.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest

Authors declare no conflict interest.

Ethical Approval

Ethical Approval Ethics committee approval (Date: 15.02.2021,Number: E-73613421-604.01.02-2102150056) was obtained from our university for the information about the data collection tools and methods to be made on the self-efficacy of pre-service science teachers in developing digital teaching materials. In addition, necessary permissions were obtained from the three universities where the research was conducted.

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Öğretmen Adaylarının Dijital Materyal Yeterliklerinin Çeşitli Değişkenler Açısından İncelenmesi

Özet:

Araştırmanın amacı Fen Bilgisi öğretmen adaylarının Web 2.0 ile dijital öğretim materyali geliştirme özyeterliklerini farklı değişkenler açısından incelemektir. Araştırma kapsamında nicel araştırma desenlerinden tarama modeli kullanılmıştır. Araştırmanın örneklemi, 3 farklı üniversitede öğrenim gören 450 öğretmen adayından oluşmaktadır. Nicel veriler "Öğretmenlerin Dijital Öğretim Materyali Geliştirme Öz-yeterlik Ölçeği" ile toplanmıştır. Verilerin analizi SPSS 25 programı ile gerçekleştirilmiştir. Veriler analiz edilirken tanımlayıcı istatistikler, Tek Yönlü Varyans Analizi ve bağımsız örneklem t testi kullanılmıştır. Bulgulara göre öğretmen adaylarının Web 2.0 ile dijital materyal geliştirme özyeterliği; okudukları üniversiteye, sınıfa ve daha önceden Web 2.0 yardımıyla dijital materyal geliştirme deneyimi olma durumuna göre anlamlı derecede farklılaşma göstermiştir. Fakat cinsiyetlerine göre özyeterlik seviyelerinde anlamlı bir farklılaşma görülmemiştir.

Anahtar kelimeler: dijital materyal, özyeterlik, Web 2.0, öğretmen adayı, fen eğitimi

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