Available online at **globets.org/journal**
International Journal of Education, Technology and Science
6(3) (2026) 291–318

IJETS
International Journal of Education Technology and Science

INVESTIGATING THE EFFECTS OF WEB 2.0 TOOLS TRAINING ON PRESERVICE TEACHERS' PERCEPTIONS OF DIGITAL COMPETENCE, 21ST-CENTURY SKILLS, AND COMPETENCIES IN THE EDUCATIONAL USE OF WEB 2.0 TOOLS

(Research article)

Ali Yağcı [a1], Cihad Şentürk [b]

[a] *Karaman Fast Reading Educational Institutions, Karaman, Türkiye, 70200, Karaman, Türkiye*
[b] *Karamanoğlu Mehmetbey University, Faculty of Education, 70200, Karaman, Türkiye*

Received: 19.03.2026 Revised version received: 27.06.2026 Accepted: 30.06.2026

Abstract

The purpose of this study was to examine the effects of training programs on the use of Web 2.0 tools in education designed for preservice teachers on their perceptions of digital competence, 21st-century skills, and Web 2.0 tool usage competencies. The study employed a one-group pretest–posttest experimental design and included 33 preservice teachers enrolled in the Faculty of Education at A state university during the spring semester of the 2023–2024 academic year. Data were collected using the Preservice Teachers' Perceptions of Digital Competence Scale, the Multidimensional 21st-Century Skills Scale, and the Web 2.0 Tools Usage Competency Scale. Power analysis, descriptive statistics, and paired-samples t-tests were used for data analysis. The findings indicated that the training programs had statistically significant, positive, and moderate-to-high effects on preservice teachers' perceptions of digital competence, 21st-century skills, and competencies in using Web 2.0 tools for educational purposes. Based on these findings, teacher education programs should incorporate systematic, practice-oriented Web 2.0 training and integrate such experiences into pedagogical and subject-specific teaching courses.

Keywords: Web 2.0 tools, web 2.0 tools training, digital competence, 21st-century skills, competencies in using web 2.0 tools, pre-service teachers

[1]Corresponding author: Ali Yağcı. ORCID ID.: https://orcid.org/0000-0003-0359-4927
E-mail: ayagci89@gmail.com
DOI: https://doi.org/10.5281/zenodo.22211832

1. Introduction

Rapid advances in science and technology have transformed not only the way individuals live and interact but also the broader structures that shape contemporary societies (Dağhan et al., 2011). Beyond facilitating everyday life, technological innovation has become a driving force in reshaping social, economic, and political systems (Bacanak et al., 2003). Reflecting these global developments, the Turkish education system initiated a major transformation with the implementation of the constructivist curriculum reform in 2005 (Yeşiltaş, 2016). At the international level, reports published by the Organisation for Economic Co-operation and Development (OECD) emphasize that investment in educational technologies has become a strategic priority for many countries seeking to improve the quality of teaching and learning, prepare individuals for rapidly changing societal demands, and promote sustainable socio-economic development. Consequently, one of the central responsibilities of contemporary education systems is to equip learners with the knowledge, skills, and competencies required to thrive in the digital age.

The effectiveness of these technological investments relies heavily on teachers, whose ability to take advantage of the advances in technology and change their teaching practices will determine the success of educational change (Özdil, 1979). Teachers are the direct agents of the curriculum in real classroom practice, therefore making a great impact on the quality of instruction and the effectiveness of education (Mahiroğlu, 2013). Thus, technology integration is effective only if it reaches beyond technical skills, combining knowledge of technology and effective pedagogy. Technopedagogy has thus been adopted as a key element of current teacher education. As defined by the Türk Eğitim Derneği [TED] (2009), technopedagogy is the capacity of teachers to connect technological tools to content areas and pedagogic approaches that improve learning, in different disciplines. Thus, technopedagogical competence implies that teachers have not only the skills to operate digital environments, but also the skills to adopt and integrate these tools into the teaching and learning context.

Increasing developments and the use of information and communication technologies have brought great changes not only to producing knowledge, but also to accessing information. In the digital world, information has been generated and utilized at a faster rate, and technological developments have greatly eliminated geographical obstacles in accessing knowledge (Şentürk, 2009). These particular changes and trends seem to raise new possibilities for existing learning environments, steering them toward more technology-enabled environments with a growing pedagogical demand. Therefore, schools and educational systems are putting more effort into reforming learning environments and using digital technologies effectively in the classroom. Such efforts are expected to facilitate the broader adoption of educational technologies while promoting more meaningful, lasting, and effective learning experiences, particularly through blended learning environments (Yağcı & Şentürk, 2023a).

Among these technological developments, Web 2.0 has emerged as one of the most influential innovations affecting educational practice. The evolution of digital literacy has been accompanied by the widespread adoption of interactive and visually rich Web 2.0 technologies, which have gradually replaced many traditional instructional resources (Fahser-Herro & Steinkuehler, 2009). Web 2.0 has enabled the internet to evolve from a means of retrieving

information into an active interaction space in which users contribute, exchange and produce content (Simões & Gouveia, 2011). As stipulated by Şentürk and Yağcı (2024), the change towards Web 2.0 shows a shift to a new paradigm of the Web in which people are no longer simple users who consume a static source of knowledge but instead active producers of information. Built on the foundation of user participation, communication and collaboration, and openness and flexibility, Web 2.0 technologies promote users not only to find information but also to take part in its creation.

In an effort to prepare students for the twenty-first century, education practices that integrate digital technologies into curriculum development, literacy pedagogy, and classroom learning are being developed (EDC, 2009). In comparison to the static design of Web 1.0, Web 2.0 envisions the web as an environment that enables activity, participation, and higher-level social interaction, therefore enabling student-centered instruction. American educational research has begun to emphasize the importance of learning environments that foster student-involved learning opportunities and that motivate students to take more ownership of their own education, as well as an acknowledgement that technology acts as a learning impetus (Anderson, 2012). In a similar vein, Stanton and Stanton (2013) found that students' active participation with Web 2.0 tools enhances their confidence in their technology skills, which are competencies that could also lead to success in their future professions. From this perspective, it is important to allow preservice teachers to have the opportunity to use Web 2.0 tools effectively to promote important twenty-first-century skills such as digital literacy, communication, collaboration, critical thinking, and problem solving. Equally important is cultivating positive attitudes toward technology integration during teacher education, as these attitudes are likely to influence the quality of the technology-rich learning environments that preservice teachers will design and implement throughout their professional careers.

Contemporary educational practices have increasingly shifted from traditional teacher-centered instruction toward learner-centered environments that emphasize active participation, collaboration, and interaction (Hainey et al., 2014). Within this pedagogical transformation, Web 2.0 technologies have become valuable instructional resources that facilitate interactive learning experiences and encourage students to participate actively in knowledge construction. Previous research has demonstrated that the effective integration of Web 2.0 tools into teaching not only enriches classroom learning but also supports more personalized and engaging learning experiences (Thiele et al., 2014; Çağır & Yağcı, 2025). Nevertheless, the educational benefits of these technologies largely depend on teachers' ability to use them confidently, purposefully, and in ways that are pedagogically appropriate. Therefore, understanding preservice teachers' digital literacy, twenty-first-century skills, and competencies in the educational use of Web 2.0 technologies has become an important focus of educational research.

With this perspective as our point of departure, the current study sets out to explore the degree to which Web 2.0 training can enhance preservice teachers' digital literacy, their twenty-first-century skills, and their overall competence in using Web 2.0 tools for educational purposes. To this end, we examine the outcomes of a structured training program, aiming to generate empirical insights into how Web 2.0-based instruction might support the very competencies that are increasingly expected of teachers working in technology-rich educational contexts today. In so doing, the study not only adds to the expanding literature on technology integration in teacher

education but also offers practical implications for how teacher preparation programs might be better designed to promote pedagogically sound and effective uses of technology. Accordingly, the study addresses the following research questions:

1. *What is the effect of Web 2.0 tools training on preservice teachers' perceptions of digital competence?*
2. *What is the effect of Web 2.0 tools training on preservice teachers' 21st-century skills?*
3. *What is the effect of Web 2.0 tools training on preservice teachers' competencies in the educational use of Web 2.0 tools?*

2. Method

2.1. Research Design

This study was designed based on a one-group pretest–posttest quasi-experimental design (Creswell, 2014). In this design, a single study group was administered a pretest prior to the intervention, followed by the implementation process, and subsequently a posttest (McMillan & Schumacher, 2014). The research design is presented in Table 1.

Table 1. Research Design

Group	Pretest	Experimental Procedure	Posttest
Preservice Teachers	T_1, T_2, T_3	Training in the Educational Use of Web 2.0 Tools (6 weeks, 30 hours)	T_1, T_2, T_3

T_1: Preservice teachers' perceptions of digital competence scale, T_2: Multidimensional 21st-century skills scale, T_3: Web 2.0 tools usage competency scale

2.2. Study Group

The study group of the research consisted of 33 preservice teachers enrolled in the Faculty of Education at A state university during the spring semester of the 2023–2024 academic year. The study group was determined using convenience sampling, one of the non-probability sampling methods. In convenience sampling, researchers work with participants who are the most accessible, continue data collection until reaching a group that meets the research needs, or focus on a sample that provides maximum diversity (Büyüköztürk et al., 2024).

During the participant selection process, an initial announcement was made to students enrolled in different teacher education programs within the Faculty of Education at A state university. The announcement was disseminated through official faculty communication channels and student groups. It provided detailed information regarding the purpose, scope, and procedures of the study, with particular emphasis on the content, duration, and participant responsibilities associated with the Web 2.0 tools training implemented within the research. An online application form was then distributed to preservice teachers who wished to take part in

the study, and applications were accepted over a one-week period. By the end of this period, 94 students had voluntarily submitted their applications.

Following participant recruitment, all eligible applicants were contacted to confirm their availability and willingness to participate in the study. A total of 40 preservice teachers agreed to participate and were enrolled in the intervention. During the implementation period, seven participants withdrew from the study because of personal reasons and did not complete the training program. Consequently, the final study sample consisted of 33 volunteer preservice teachers who successfully completed the intervention. The demographic characteristics of the participants are presented in Table 2.

Table 2. Demographic Characteristics of the Preservice Teachers Participating in the Study

Variables	**Category**	**Preservice Teachers**	
		n	**%**
Gender	Female	21	63.6
	Male	12	36.4
Grade Level	First Year	6	18.2
	Second Year	12	36.4
	Third Year	6	18.2
	Fourth Year	9	27.3
Program	Science Education	5	15.2
	Primary Mathematics Education	6	18.2
	Preschool Education	3	9.1
	Special Education	3	9.1
	Guidance and Psychological Counseling	5	15.2
	Primary School Education	6	18.2
	Turkish Language Education	5	15.2

Table 2 presents the demographic characteristics of the preservice teachers who were participants in the study group. There were 33 preservice teachers out of which 21of them (63.6%) were female and 12 (36.4%) were male. Regarding the participants, 36.4%(n=12) of the group were second years, 27.2%(n=9) fourth years and 18.2%(n=6) first years and third years. As to their departments of study, the largest number of participants, 18.2%(n= 6) of the group, were from Elementary Mathematics Education and Primary Education. The departments of Science Education, Guidance and Psychological Counseling, and Turkish Language Education each accounted for 15.2% (n= 5) of the participants while Early Childhood Education and Special Education consisted of 9.0% of the whole group (n= 3). Overall, these distributions

indicate that the study group comprised a heterogeneous sample of preservice teachers from different year levels and academic departments.

2.3. Implementation Process

Prior to data collection, ethical approval for the study was obtained from the Social and Human Sciences Research and Publication Ethics Committee of a Karamanoğlu Mehmetbey University (Approval Date: April 26, 2024; Decision No. 07-2024/151). Institutional permission was subsequently granted by the Dean's Office of the Faculty of Education to conduct the study with preservice teachers. Before the training commenced, all participants were informed about the purpose, scope, and procedures of the research. Written informed consent was obtained from each participant, and participation was entirely voluntary.

The Web 2.0 training program took place over a six-week period, running from May through June 2024 in the computer laboratories of the Faculty of Education at a state university. Sessions were held on weekday evenings, starting after 4:00 p.m., with five hours of instruction per week, amounting to a total of 30 contact hours. Prior to the start of the program, participants were made aware that regular and sustained attendance throughout the training was a prerequisite.

The training was structured around three interrelated components: theoretical input, practical demonstrations, and hands-on activities, both individual and collaborative in nature. Throughout the sessions, participants received ongoing guidance and on-the-spot feedback as they worked with various Web 2.0 tools. Any technical issues that came up during the activities were addressed promptly, and at the end of each session, the products created by the participants were reviewed together as a group. A strong emphasis was placed on active involvement, peer cooperation, and the transfer of newly acquired knowledge to authentic teaching and learning contexts. In addition, dedicated time was set aside for reflection and whole-group discussion, both to consolidate learning and to encourage participants to critically assess their own experiences. Throughout the training, attendance was monitored, participants' engagement in the activities was observed, and the instructional products developed during the sessions were systematically documented. The weekly schedule of the training program and the activities implemented each week are presented below.

Week 1

During the first week of the training program on the use of Web 2.0 tools in education, preservice teachers were informed about digital literacy, 21st-century skills, and Web 2.0 technologies *(Coggle, Figma, Gitmind, Lucidchart, Mindmeister, Miro, Smartdraw, Wisemapping)* and digital bulletin board applications *(Bubble, Draft, Jamboard, Note.Ly, Notebookcast, Padlet, Scrumblr, Tascade, Twiddla, Whiteboard.Fi)*. Subsequently, training sessions on mind mapping Web 2.0 tools were conducted, and sample applications were

demonstrated. Following these activities, the preservice teachers were encouraged to use the relevant Web 2.0 tools and engage in hands-on practice activities related to the topic.

Week 2

During the second week of the training program, the advantages of Web 2.0 tools were discussed. Subsequently, preservice teachers received training on Web 2.0 tools for cartoon and poster creation *(Canva, Crello, Greetingsisland, Make Beliefs Comix, Pixton, Photopea)* as well as story and book writing tools *(Mystorybook, Pixton, Storybird, Storyboardthat, Storyjumper)*, and sample activities were conducted. Following these demonstrations, the participants were encouraged to use these Web 2.0 tools and engage in practical application activities.

Week 3

During the third week of the training program, the disadvantages of Web 2.0 tools were discussed. Subsequently, preservice teachers received training on Web 2.0 tools designed for note-taking and blog creation *(Blogger, Evernote, Keep.google, Monday, Trello, Tumblr)*, test, quiz, puzzle, and word cloud creation *(Denemem, Interacty.me, Kahoot, Puzzel, Quizizz, Quizlet, Siyosis, WordArt, Wordle, Wordwall)*, as well as presentation and animation applications *(Buncee, Canva, Emaze, Genially, Visme, Powtoon, Prezi, Venngage)*. Sample activities were implemented following the instructional demonstrations, and the participants were encouraged to use these Web 2.0 tools through hands-on practice activities.

Week 4

During the fourth week of the training program, emphasis was placed on the importance of using Web 2.0 tools in educational settings, and the pedagogical contributions that these tools can provide to the instructional process were discussed in detail. In this context, sample applications demonstrating how and for what purposes Web 2.0 tools could be integrated into teaching processes were presented. Subsequently, preservice teachers received practical training on infographic and information poster creation Web 2.0 tools *(Creately, Easelly, Piktochart, Venngage, Visme)* as well as distance education and virtual classroom Web 2.0 tools *(Whiteboard, EBA, Edmodo, Google Classroom, Moodle, Second Life, Zoom)*. Throughout the training process, sample activities based on these tools were implemented, and active participation of the preservice teachers was encouraged. Following the training sessions, the participants were asked to use the introduced Web 2.0 tools in both individual and collaborative practice activities.

Week 5

During the fifth week of the training program, the role of Web 2.0 tools in educational processes and their contributions to teaching–learning environments were discussed, and sample applications demonstrating how these tools could be used for different instructional purposes across various courses were presented. Subsequently, preservice teachers received training on artificial intelligence applications *(OpenAI [ChatGPT, DALL·E], Opinion Stage, PopAi, Sider, Submagic, Synthesia AI, TutorAI)*, photo and video editing and design applications *(Canva, CapCut, Clipchamp, Kapwing, Movie Maker, OpenShot, Veed.io, Vimeo)*, and social media applications *(Facebook, Hangouts, Instagram, Skype, YouTube, WebQuest, WhatsApp, Wiki, X)* within the scope of Web 2.0 tools. During the training process, sample activities related to the

pedagogical use of these tools were implemented, and preservice teachers were encouraged to actively participate and directly experience the applications. At the end of the process, the participants were asked to develop their own original applications using the introduced Web 2.0 tools.

Week 6

During the sixth week of the training program, the Web 2.0 tools introduced throughout the previous weeks and the activities conducted with these tools were comprehensively reviewed and evaluated. Sample applications developed during the training process were presented and collectively examined. Subsequently, preservice teachers received training on Web 2.0 tools related to virtual and augmented reality *(Animal 4D, Aurasma, Chromeville, Eyejack, Morfo, Nearpod, Space 4D, Quiver, Web Miro, and 360Cities)* and sample activities were conducted.

Following the demonstrations, preservice teachers were given opportunities to explore each Web 2.0 tool through guided hands-on activities and were encouraged to incorporate these tools into instructional tasks. The Web 2.0 training program was carried out over the course of six weeks, with a total of 30 hours of instruction. Designed with the aim of strengthening preservice teachers' pedagogical use of Web 2.0 technologies, the program combined theoretical grounding with extensive hands-on practice. In the early sessions, participants were introduced to the educational affordances of Web 2.0 tools and their role in supporting contemporary approaches to teaching and learning. As the program progressed, they took part in a range of authentic learning activities that allowed them to select, evaluate, and implement appropriate digital tools for various instructional goals. Importantly, the program did not concentrate merely on technical proficiency; rather, it placed greater weight on the pedagogically sound integration of Web 2.0 technologies into everyday classroom practice. Below are representative photographs that illustrate some of the activities carried out during the training.

Figure 1. General Views from the Web 2.0 Training Sessions

2.4. Data Collection Instruments

The data of the study were collected using the "Preservice Teachers' Perceptions of Digital Competence Scale", the "Multidimensional 21st-Century Skills Scale", and the "Web 2.0 Tools Usage Competency Scale". Brief information regarding these scales is presented below.

2.4.1. Preservice Teachers' Perceptions of Digital Competence Scale

The "Preservice Teachers' Perceptions of Digital Competence Scale" developed by Karakuş et al. (2022), was employed to assess preservice teachers' perceptions of digital competence. The scale consists of 26 items distributed across three subdimensions and is structured as a five-point Likert-type instrument without reverse-coded items. The subdimensions include media and communication competencies, instructional design competencies in digital environments, and information technology competencies. To establish construct validity, both exploratory and confirmatory factor analyses were conducted, and the confirmatory factor analysis demonstrated acceptable model fit indices (χ^2/df= 2.41, RMSEA= .064, SRMR= .060, CFI= .92). In addition, the Cronbach's alpha reliability coefficients for the subdimensions ranged between .88 and .90, indicating a high level of internal consistency. These findings indicate that the scale is a highly reliable instrument for measuring preservice teachers' perceptions of digital competence.

2.4.2. Multidimensional 21st Century Skills Scale

In the present study, the "Multidimensional 21st-Century Skills Scale" developed by Çevik and Şentürk (2019), was employed to assess preservice teachers' 21st-century skills. The instrument consists of 41 items grouped into five subdimensions, with responses recorded on a five-point Likert-type scale. It also includes several reverse-coded items. The five dimensions assess information and technology literacy, critical thinking and problem solving, entrepreneurship and innovation, social responsibility and leadership, and career awareness.

The psychometric properties of the instrument were established through both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The KMO value was .88, indicating that the data were suitable for factor analysis, and all item–total correlation coefficients exceeded .50. The CFA supported the proposed factor structure, yielding acceptable fit indices (χ^2/df = 2014.17/774, RMSEA = .05, SRMR = .058, GFI = .90, CFI = .95). Internal consistency was also satisfactory, with an overall Cronbach's alpha coefficient of .86 and subscale reliability coefficients ranging from .73 to .84. Collectively, these results provide evidence that the instrument yields valid and reliable measurements of preservice teachers' twenty-first-century skills.

2.4.3. Web 2.0 Tools Usage Competency Scale

In this study, preservice teachers' competency in using Web 2.0 tools was assessed using the Web 2.0 Tools Usage Competency Scale developed by Çelik (2021). The instrument is a one-dimensional measure comprising 39 items rated on a five-point Likert scale and does not contain any reverse-coded items. Evidence for the instrument's validity was provided through both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The KMO value was .97, indicating excellent sampling adequacy, and all item–total correlation coefficients exceeded .40.The CFA results indicated acceptable model fit indices (χ^2/df= 4.83, RMSEA= .098, CFI=

.98, TLI= .98). In the reliability analysis, the Cronbach's alpha coefficient of the scale was calculated as .98. These findings suggest that the scale is a valid and highly reliable instrument for assessing preservice teachers' competencies in the use of Web 2.0 tools.

2.5. Data Analysis

The data obtained in the study were analyzed using the Jamovi (Version 2.7.5) statistical software package. Initially, the normality of the data distribution was examined. According to the literature, the Kolmogorov–Smirnov test is recommended for studies with more than 50 participants, whereas the Shapiro–Wilk test is considered more appropriate for studies involving fewer than 50 participants (Büyüköztürk et al., 2024). Since the study group consisted of 33 preservice teachers, the Shapiro–Wilk test was employed to assess normality.

The Shapiro–Wilk test indicates that the data demonstrate a normal distribution when the probability value is greater than .05 (p>.05), whereas values below .05 (p<.05) suggest non-normal distribution (Büyüköztürk, 2007). Moreover, the Shapiro–Wilk test has been reported to yield more reliable results for small sample sizes when assessing normality assumptions (Shapiro & Wilk, 1965). The results of the Shapiro–Wilk analysis revealed that the p values obtained from the scales were greater than .05, indicating that the data were normally distributed. In addition, a post hoc power analysis was conducted to evaluate the statistical power of the study. The power analysis was performed using G*Power (Version 3.1.9.7), considering the effect size (Cohen's d) values associated with the experimental effect. For the dependent samples t-test, the significance level was set at α = .05 (Type I error probability), and the sample size was specified as n= 33. The findings demonstrated that the statistical power values corresponding to the effect sizes obtained from the relevant scales were above .97. This result indicates that the sample size was sufficient for achieving the objectives of the study. The power analysis graphs related to the data obtained from the three scales used in the quantitative dimension of the study are presented below.

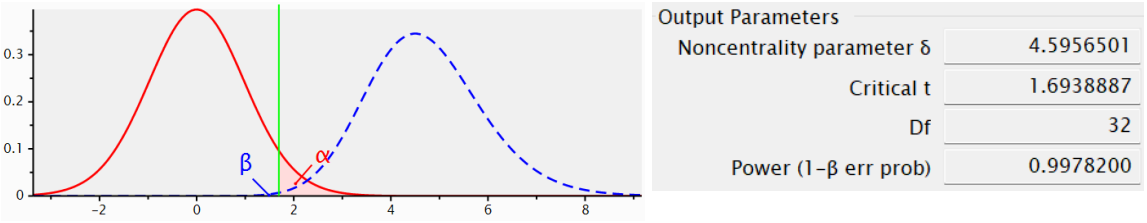

Figure 2. Power Analysis of the Preservice Teachers' Perceptions of Digital Competence Data

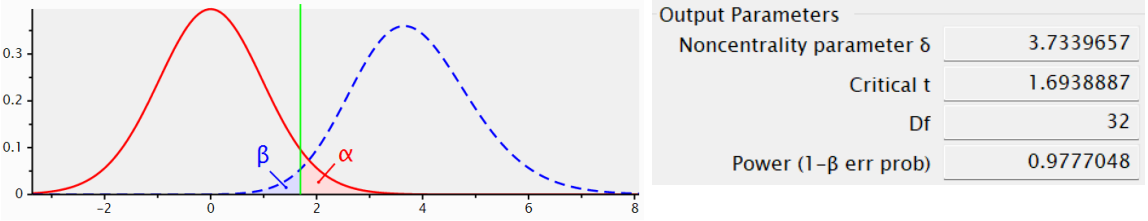

Figure 3. Power Analysis of the Preservice Teachers' Multidimensional 21st-Century Skills Data

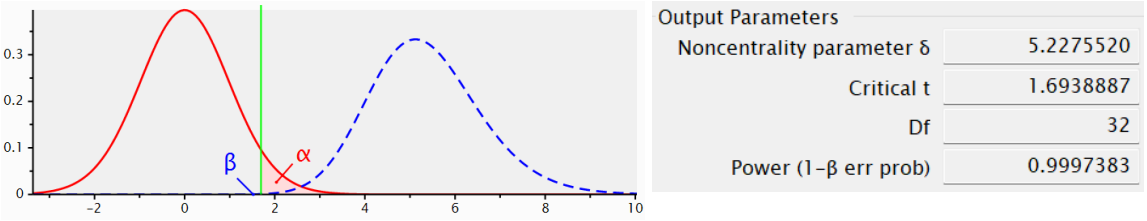

Figure 4. Power Analysis of the Preservice Teachers' Web 2.0 Tools Usage Competency Data

An examination of the values presented in the figures indicates that the analyses conducted under the current study conditions were statistically highly robust (high effect size, sufficient sample size, α= .05). Accordingly, the sample size was adequate to detect a statistically significant relationship, if present, and the risk of Type II error (β) was negligible (Faul et al., 2009).

Within the quantitative phase of the research, the analysis began with a comparison of preservice teachers' pretest and posttest scores obtained from three measurement instruments: the Preservice Teachers' Perceptions of Digital Competence Scale, the Multidimensional 21st-Century Skills Scale, and the Web 2.0 Tools Usage Competency Scale. Before selecting the appropriate statistical procedures, the distribution of the data was examined to determine whether the assumptions required for parametric analyses were satisfied. As the results indicated that the data were normally distributed, parametric statistical techniques were considered appropriate. Descriptive statistics, including frequencies, percentages, arithmetic means, and standard deviations, were calculated to summarize participants' scores. To determine whether participation in the Web 2.0 training program resulted in statistically significant changes in the measured variables, paired-samples *t*-tests were performed by comparing participants' pretest and posttest scores on each instrument.

To ensure the quality of the research process, several methodological precautions were taken to enhance the validity and reliability of the study. Data were collected in a controlled classroom environment using three standardized instruments with well-established psychometric properties. Prior to the main implementation, a pilot study was conducted to examine the clarity of the research procedures, identify potential implementation challenges, and evaluate the feasibility of the data collection process. The findings from the pilot study informed minor refinements to the implementation procedures before the intervention was carried out. Based on the observations obtained during the pilot study, minor procedural adjustments were made before the main application.

Particular attention was also paid to reducing potential threats to internal validity. To minimize the possible influence of pretest sensitization, maturation, and history effects, a six-week interval was maintained between the pretest and posttest administrations. Throughout both measurement sessions, participants completed the instruments under comparable conditions and received the same instructions from the researchers. Maintaining standardized administration procedures helped ensure consistency across the data collection process and reduced the likelihood that differences in testing conditions would influence the results. In addition, all measurement instruments employed in the study had previously demonstrated satisfactory

evidence of validity and reliability, thereby strengthening the credibility of the findings obtained in the present research.

3. Results

In this section of the study, the findings related to the research are systematically presented in accordance with the order of the research questions.

3.1. Findings Related to the Effect of Web 2.0 Tools Training on Preservice Teachers' Perceptions of Digital Competence

The first research question of the study was formulated as follows: *"What is the effect of Web 2.0 tools training on preservice teachers' perceptions of digital competence?"* The arithmetic means ($\bar{x}$), standard deviations (*SD*), and paired-samples *t*-test results regarding the scores obtained by the preservice teachers from the "Preservice Teachers' Perceptions of Digital Competence Scale" before and after the training are presented in Table 3.

Table 3. Paired-Samples *t*-Test Results for the Pretest and Posttest Scores of Preservice Teachers' Perceptions of Digital Competence

Preservice Teachers' Perceptions of Digital Competence	**Experimental Group**	**n**	$\bar{x}$	***SD***	***df***	***t***	***p***	***r***
Media and Communication Competencies	Pretest	33	34,48	5,52	32	-2,745	,010*	0,44
	Posttest		37,24	3,19				
Competencies in Designing Instruction in Digital Environments	Pretest	33	27,30	6,71	32	-6,881	,000*	0,77
	Posttest		35,57	4,16				
Information Technology Competencies	Pretest	33	34,63	6,66	32	-8,525	,000*	0,83
	Posttest		43,03	5,00				
TOTAL	Pretest	33	96,27	16,18	32	-7,586	,000*	0,80
	Posttest		115,84	11,45				

** $p<.01$

As shown in Table 3, statistically significant differences were identified between the pretest and posttest scores of the preservice teachers in the experimental group regarding their perceptions of digital competence. In the "media and communication competencies" subdimension, a statistically significant difference was found in favor of the posttest scores [$t_{(32)}= -2.745$, $p<.05$]. This finding suggests that the Web 2.0 tools training implemented within the scope of the study contributed to the improvement of preservice teachers' media and communication competencies. The effect size for this comparison was $r= .44$, representing a moderate effect based on Cohen's (1988) criteria.

A similar pattern emerged for the competencies in designing instruction in digital environments subdimension. Participants achieved significantly higher scores after the training than before it [$t_{(32)}$= -6.881, p< .01], suggesting that the Web 2.0 training program contributed substantially to their ability to design instruction in digital learning environments. The effect size was large (r = .77), indicating a substantial practical effect.

Posttest scores on the information technology competencies subdimension were significantly higher than pretest scores [$t_{(32)}$ = -8.525, p< .01]. This result suggests that the training program contributed to the development of preservice teachers' competencies in the educational use of information technologies. The effect size for this dimension (r= .83) likewise reflected a large effect, indicating that the observed improvement was not only statistically significant but also educationally meaningful.

A comparison of the overall scores on the Preservice Teachers' Perceptions of Digital Competence Scale further demonstrated a significant increase from pretest to posttest [$t_{(32)}$= -7.586, p< .01. Overall, these findings indicate that the Web 2.0 training program was associated with substantial improvements in preservice teachers' perceptions of their own digital competence. The overall effect size was r= .80, which is considered large according to Cohen's (1988) guidelines. The distribution of pretest and posttest scores obtained from the scale is presented in Figure 5.

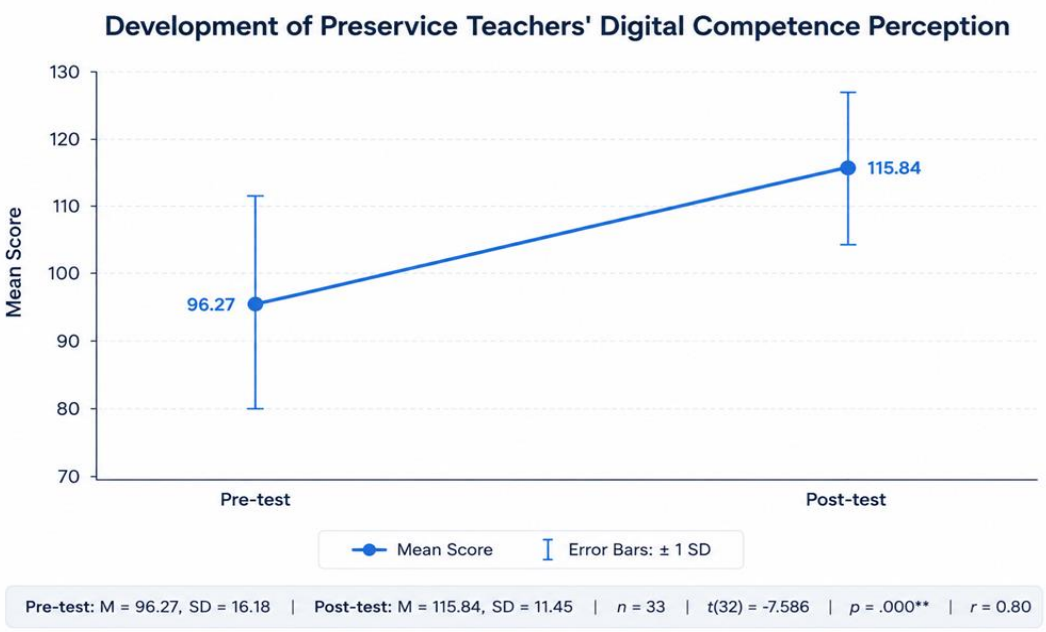

Figure 5. Development of Preservice Teachers' Perceptions of Digital Competence

Overall, the findings suggest that participation in the Use of Web 2.0 Tools in Education training program was associated with meaningful improvements in preservice teachers' perceptions of digital competence. The increase observed from pretest to posttest, together with the large effect sizes, indicates that these improvements extended beyond statistical significance and reflected changes of practical educational relevance. The findings indicate that when preservice teachers are given regular opportunities to explore and work with Web 2.0 tools in authentic educational

settings, this not only boosts their confidence in using digital technologies but also strengthens their perceived ability to integrate such tools into their future teaching. These outcomes further underscore the importance of embedding technology-rich, practice-oriented learning experiences into preservice teacher education programs, a move that appears critical for equipping future teachers to navigate and thrive in digitally enhanced teaching and learning environments.

3.2. Findings Related to the Effect of Web 2.0 Tools Training on Preservice Teachers' 21st-Century Skills

The second research question of the study was formulated as follows: *"What is the effect of Web 2.0 tools training on preservice teachers' 21st-century skills?"* The arithmetic means ($\bar{x}$), standard deviations (*SD*), and paired-samples *t*-test results regarding the scores obtained by the preservice teachers from the "Multidimensional 21st-Century Skills Scale" before and after the training are presented in Table 4.

Table 4. Paired-Samples *t*-Test Results for the Pretest and Posttest Scores of Preservice Teachers' Multidimensional 21st-Century Skills

Multidimensional 21st-Century Skills	**Experimental Group**	**n**	$\bar{x}$	***SD***	***df***	***t***	***p***	***r***
Information and Technology Literacy	Pretest	33	59,78	7,17	32	-4,220	,000*	0,60
	Posttest		64,54	6,36				
Critical Thinking and Problem Solving	Pretest	33	25,00	3,93	32	-1,918	,064	-
	Posttest		26,18	3,63				
Entrepreneurship and Innovation	Pretest	33	35,66	6,19	32	-4,006	,000*	0,58
	Posttest		39,27	5,77				
Social Responsibility and Leadership	Pretest	33	15,15	2,57	32	-2,031	,051	-
	Posttest		15,78	2,57				
Career Awareness	Pretest	33	27,24	2,87	32	-0,979	,335	-
	Posttest		27,75	2,71				
TOTAL	Pretest	33	162,84	16,39	32	-4,816	,000*	0,65
	Posttest		173,54	17,16				

* $p<.01$

Table 4 indicates that statistically significant differences existed between the pretest and posttest scores of the preservice teachers in the experimental group regarding their 21st-century skills. In the "information and technology literacy" subdimension, a statistically significant difference was identified in favor of the posttest scores [$t_{(32)}= -4.220$, $p<.01$]. This finding suggests that the Web 2.0 tools training contributed positively to the development of preservice

teachers' information and technology literacy skills. The calculated effect size was r= .60, indicating a moderate effect according to Cohen's (1988) classification criteria.

In the "critical thinking and problem solving" subdimension, the difference between the pretest and posttest scores was not found to be statistically significant [$t_{(32)}$= -1.918, p>.05]. This result indicates that the training program did not produce a statistically significant effect on preservice teachers' critical thinking and problem-solving skills. A statistically significant difference in favor of the posttest scores was observed in the "entrepreneurship and innovation" subdimension [$t_{(32)}$= -4.006, p<.01]. This finding demonstrates that the Web 2.0 tools training was effective in improving preservice teachers' entrepreneurship and innovation skills. The effect size obtained for this dimension was r= .58, corresponding to a moderate effect size. On the other hand, the differences between the pretest and posttest scores in the "social responsibility and leadership" [$t_{(32)}$= -2.031, p>.05] and "career awareness" [$t_{(32)}$= -0.979, p>.05] subdimensions were not statistically significant. These findings indicate that the training program did not have a significant effect on preservice teachers' social responsibility and leadership skills or career awareness. When the total scores obtained from the "Multidimensional 21st-Century Skills Scale" were examined, a statistically significant difference was found between the pretest and posttest scores in favor of the posttest [$t_{(32)}$= -4.816, p<.01]. This finding suggests that the Web 2.0 tools training had a positive effect on the overall development of preservice teachers' 21st-century skills. The calculated effect size for the total scale score was r= .65, indicating a moderate effect according to Cohen's (1988) classification. The distribution of the pretest and posttest scores obtained from the "Multidimensional 21st-Century Skills Scale" is presented in Figure 6.

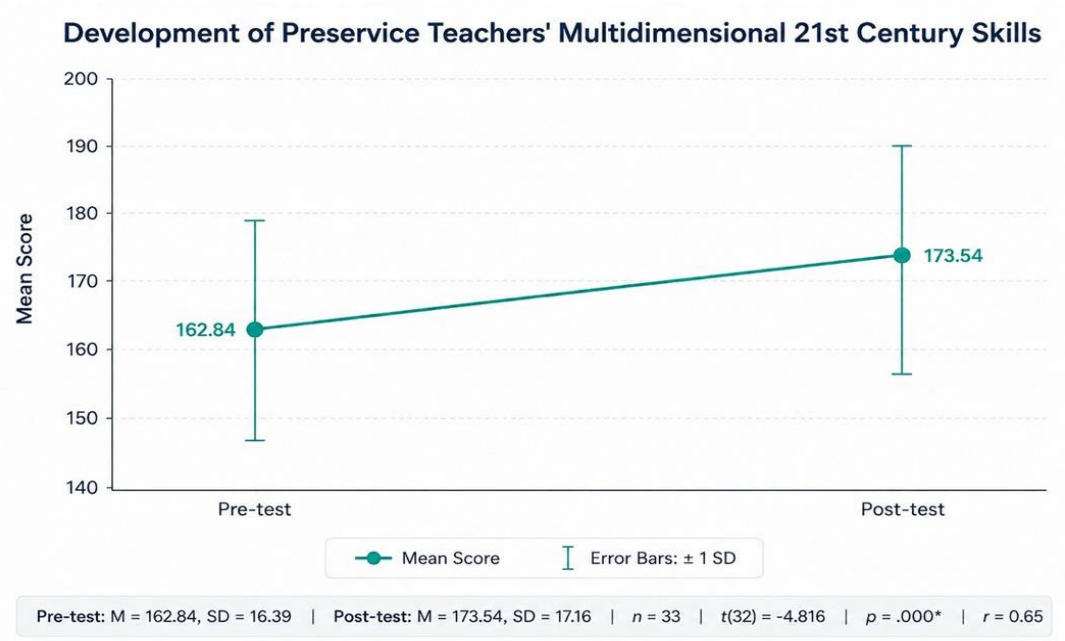

Figure 6. Development of Preservice Teachers' 21st-Century Skills

Overall, the findings suggest that the Use of Web 2.0 Tools in Education training program contributed positively to preservice teachers' development of twenty-first-century skills. Improvements were observed in the overall scale scores, indicating that participants benefited from the training in several dimensions of these competencies. The largest improvements were observed in the information and technology literacy and entrepreneurship and innovation dimensions, both of which showed statistically significant gains of moderate magnitude. By contrast, no statistically significant differences were found for the critical thinking and problem-solving, social responsibility and leadership, or career awareness dimensions. These findings indicate that a short-term training program can effectively support the development of technology-related competencies and innovative thinking. However, competencies associated with higher-order thinking, social responsibility, and career development may require more sustained educational experiences and longer periods of instructional support. Overall, the findings suggest that the *"Use of Web 2.0 Tools in Education"* training program played an effective and functional role in enhancing preservice teachers' 21st-century skills.

3.3. Findings Related to the Effect of Web 2.0 Tools Training on Preservice Teachers' Competencies in the Use of Web 2.0 Tools

The third research question of the study was formulated as follows: *"What is the effect of Web 2.0 tools training on preservice teachers' competencies in the educational use of Web 2.0 tools?"* The arithmetic means ($\bar{x}$), standard deviations (*SD*), and paired-samples *t*-test results regarding the scores obtained by the preservice teachers from the "Web 2.0 Tools Usage Competency Scale" before and after the training are presented in Table 5.

Table 5. Paired-Samples *t*-Test Results for the Pretest and Posttest Scores of Preservice Teachers' Competencies in the Use of Web 2.0 Tools

Web 2.0 Tools Usage Competency	**Experimental Group**	**n**	$\bar{x}$	***SD***	***df***	***t***	***p***	***r***
Single Dimension TOTAL	Pretest	33	92,18	38,20	32	-12,160	,000*	0,91
	Posttest		169,75	18,99				

* $p<.01$

As presented in Table 5, statistically significant differences were identified between the pretest and posttest scores of the preservice teachers in the experimental group regarding their competencies in the use of Web 2.0 tools. The comparison of the pretest and posttest scores revealed a statistically significant difference in favor of the posttest scores [$t_{(32)}$= -12.160, $p<.01$]. This finding indicates that the Web 2.0 tools training implemented within the scope of the study was effective in improving preservice teachers' competencies in the use of Web 2.0 tools. The calculated effect size was r= .91, which corresponds to a very high level of effect according to Cohen's (1988) classification criteria. The distribution of the pretest and posttest scores obtained from the "Web 2.0 Tools Usage Competency Scale" is presented in Figure 7.

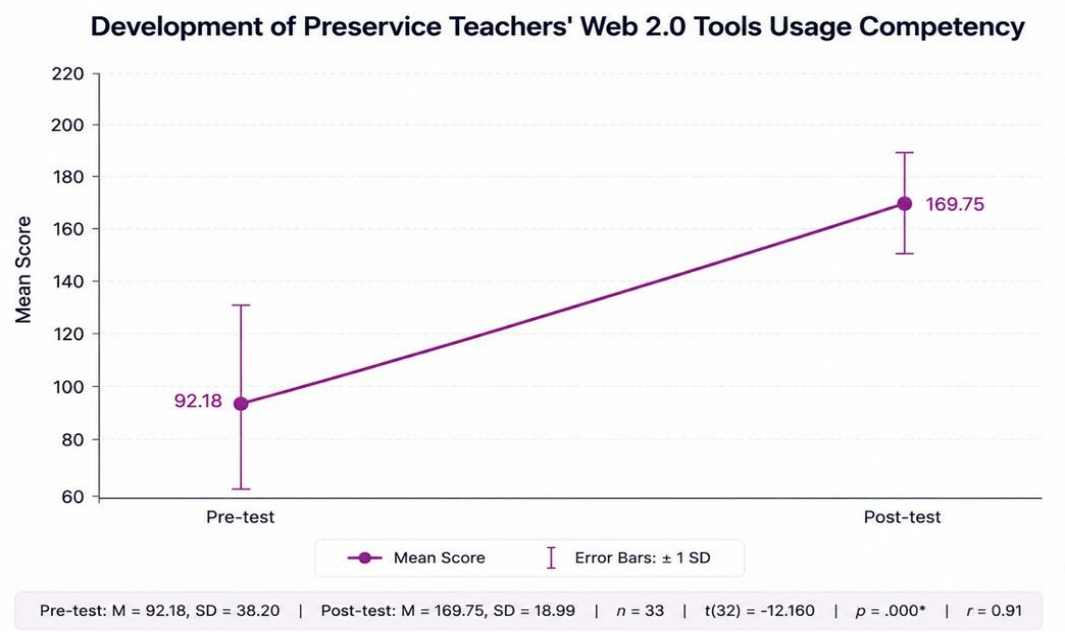

Figure 7. Development of Preservice Teachers' Web 2.0 Tools Usage Competency

When the findings are evaluated as a whole, it can be concluded that the *"Use of Web 2.0 Tools in Education"* training program substantially improved preservice teachers' competencies in the use of Web 2.0 tools and played an effective and functional role in the development of these competencies. The improvement observed across participants suggests that the training provided a supportive learning environment for developing this competency. These findings indicate that regular opportunities to engage with Web 2.0 tools through structured, practice-oriented activities can make a meaningful contribution to strengthening preservice teachers' skills in this area.

4. Discussion

The findings of this study show that Web 2.0 training had a generally positive and statistically significant effect on preservice teachers' digital competence, twenty-first-century skills, and competencies in using Web 2.0 tools. It should be noted, however, that the degree of improvement was not uniform across all dimensions examined. The most pronounced gains were observed in competencies directly tied to technology use and instructional design, whereas shifts in broader cognitive and professional competencies proved to be relatively modest.

The findings related to the first subproblem show that training on the educational use of Web 2.0 tools significantly improved preservice teachers' perceptions of digital competence. In particular, the large effect sizes observed in information technology competencies, instructional design in digital environments, and the overall scale score are noteworthy. This finding indicates that Web 2.0 training may contribute not only to technical skills but also to digital pedagogical competence and confidence in technology integration. The finding is consistent with the TPACK framework proposed by Mishra and Koehler (2006), which emphasizes the integration of technological, pedagogical, and content knowledge. The collaborative and production-

oriented nature of Web 2.0 tools may have supported preservice teachers in designing digital learning environments (Chai et al., 2013). Scherer et al. (2019) similarly reported that technology-based teacher education interventions can have substantial effects on instructional design competencies.

A moderate effect was found for media and communication competencies. This result may be related to the communicative and collaborative characteristics of Web 2.0 tools, which provide opportunities to produce, share, and discuss digital content. Jenkins et al. (2009) emphasized that Web 2.0 environments support users' participation in media production and sharing. Krumsvik (2011) also noted that the pedagogical integration of digital technologies can strengthen teachers' ability to design learning environments through digital media. However, Tondeur et al. (2012) pointed out that beliefs about technology integration may be as important as the content of technology-related training. Therefore, the moderate effect found in the present study may also be related to participants' previous experiences with technology and their pedagogical beliefs. In addition, media and communication competence involves several dimensions, including ethical and safety-related issues (Li et al., 2021).

Among the more noteworthy outcomes was the progress preservice teachers made in their capacity to design instruction for digital environments. This finding points to a shift in how participants came to view technology, not merely as a technical resource to be used, but as an integral component of the instructional design process itself. Mishra and Koehler (2006) contend that successful technology integration hinges on the interplay between technological, pedagogical, and content knowledge. Given the project-based, collaborative, and student-centered nature of Web 2.0 tools, it seems plausible that these technologies offer a conducive context for fostering TPACK development (Chai et al., 2013). Similarly, within the framework of Puentedura's (2006) SAMR model, such tools may enable preservice teachers to move beyond merely replicating traditional tasks and toward designing activities that transform the learning experience. At the same time, Tondeur et al. (2018) remind us that post-graduation technology integration is often mediated by factors such as school infrastructure, curricular constraints, and collegial support. Consequently, whether the gains observed in this study will translate into sustained classroom practice remains a question that warrants further investigation.

The large effect found in information technology competencies indicates that preservice teachers improved their ability to use information and communication technologies, produce digital content, and deal with technology-related problems. This finding is consistent with the "digital resources" and "assessment" dimensions of the DigCompEdu framework (European Commission, 2017). Ferrari (2012) similarly defined digital competence as extending beyond basic technology use to include the creative and critical use of digital tools. Hatlevik and Christophersen (2013) also reported a relationship between teachers' perceptions of digital competence and their confidence in using technology. However, digital competence also includes ethical use, data security, and digital citizenship (Ribble, 2015). For this reason, these areas could receive greater attention in future teacher education programs.

The overall findings regarding digital competence can also be considered from social constructivist (Vygotsky & Cole, 1978) and connectivist (Siemens, 2005) perspectives. Web 2.0

environments provide opportunities for interaction, collaboration, and knowledge construction, which may have supported the development of preservice teachers' digital competence. Falloon (2020) similarly argues that preservice teachers' digital competence should be considered as an integrated professional capability rather than as a collection of independent skills. The findings of the present study support this view, since improvements were observed across media and communication, instructional design, and information technology competencies.

Turning to the second subproblem, the findings reveal that the impact of Web 2.0 training on twenty-first-century skills was not uniform across all dimensions. Statistically significant gains were observed in information and technology literacy as well as entrepreneurship and innovation. In contrast, no meaningful changes were detected in critical thinking and problem solving, social responsibility and leadership, or career awareness. At the aggregate level, however, the training yielded a moderate yet statistically significant overall effect on twenty-first-century skills. This differential pattern may be attributable to the specific characteristics of Web 2.0 tools and the instructional approaches employed during the training process.

The observed improvement in information and technology literacy is likely linked to the nature of the activities participants engaged in. Throughout the training, they accessed digital information, evaluated online resources, produced multimedia content, and shared their work through various Web 2.0 platforms. Such tasks are closely aligned with the core dimensions of information literacy, namely the ability to access, evaluate, and use information effectively (P21, 2009; Mackey & Jacobson, 2011; Leu et al., 2013). In a similar vein, the American Library Association (1989) defines information literacy in terms of these very competencies. Web 2.0 environments are also inherently designed to support active user participation in analyzing, synthesizing, and sharing information (Mackey & Jacobson, 2011). Leu et al. (2013) have further pointed out that emerging digital literacy contexts can facilitate the social construction of knowledge. At the same time, it is worth noting that Wineburg and McGrew (2019) caution that assessing the credibility of online information demands more advanced evaluative and reasoning skills. This may help explain why the effect observed in the present study was only moderate in magnitude, possibly reflecting the relatively limited duration and scope of the training program.

No significant improvement was observed in critical thinking and problem-solving skills. This finding does not necessarily imply that Web 2.0 tools are incapable of supporting higher-order thinking. Rather, it may simply suggest that technology on its own is insufficient for fostering such competencies. While some studies have reported positive effects of digital learning environments on critical thinking (Lai, 2011; Hwang et al., 2018), Tsai et al. (2011) have drawn attention to the critical role of pedagogical design in shaping the educational outcomes of technology use. In the case of the present study, the training was primarily focused on helping participants learn how to use Web 2.0 tools and apply them in educational activities, which may explain why deeper cognitive gains were not achieved. As a result, participants may have had limited opportunities for sustained inquiry, complex problem solving, and reflective thinking. Facione (1990) considers critical thinking a complex and reflective process that develops over time. Kruger and Dunning (1999) also showed that individuals may have difficulty accurately judging their own cognitive abilities. For this reason, the absence of a significant change in the

present study may reflect both the relatively short duration of the intervention and the use of self-report measures.

The significant improvement in entrepreneurship and innovation suggests that Web 2.0 training contributed to preservice teachers' perceptions of creativity, innovative thinking, and digital production. Anderson (2007) describes Web 2.0 environments as creative spaces in which users can produce and transform content. Zhao (2012) similarly argues that teachers in the digital age should not only transmit knowledge but also design learning experiences. The European Commission (2016) relates entrepreneurial competence to transforming opportunities into action and developing creativity and innovation. In this respect, the practical and project-based Web 2.0 activities used in the present study may have provided an appropriate context for developing innovative thinking. However, Ratten and Usmanij (2021) noted that the sustained development of entrepreneurial competencies requires more comprehensive and long-term educational experiences.

No significant changes were found in social responsibility and leadership or career awareness. This finding may be related to the focus of the training, which was mainly directed toward technology use and digital content production. Choi (2016) noted that Web 2.0 tools have the potential to support social responsibility, but such outcomes require learning environments with explicit ethical and social goals. Ribble (2015) likewise emphasized that digital citizenship includes communication, ethics, rights, and responsibilities. Therefore, the absence of significant change in social responsibility and leadership may be understandable given the content and duration of the intervention.

Career awareness also involves a more complex set of factors, including long-term professional goals, personal values, and environmental conditions. Social Cognitive Career Theory (Lent et al., 1994) explains career development as a function of self-efficacy beliefs, outcome expectations, and contextual factors. Viewed through this lens, a short-term Web 2.0 training program would not necessarily be expected to bring about substantial changes in career awareness. This finding further suggests that technology-focused courses may have a more direct impact on technology-related competencies than on professional outcomes that tend to unfold gradually over the course of teacher education and early career experiences.

The findings related to the third subproblem reveal a statistically significant and strong increase in preservice teachers' self-efficacy in using Web 2.0 tools. The large effect size indicates that the training substantially enhanced participants' confidence in working with these technologies. This result can be understood within the framework of Bandura's (1977) Social Cognitive Theory. According to Bandura, self-efficacy refers to individuals' beliefs about their capacity to accomplish a given task, and direct experiences are a key factor in the formation of these beliefs. In the present study, the process of developing concrete digital products, including blogs, videos, podcasts, and interactive presentations, may have reinforced participants' conviction that they were capable of using Web 2.0 tools successfully (Schunk & DiBenedetto, 2020). Scherer et al. (2019) have similarly reported that technology-related self-efficacy serves as an important predictor of teachers' intentions to integrate technology into their instructional practice.

The findings can also be considered in relation to Bloom's (1968) Mastery Learning model. The model assumes that appropriate learning conditions and sufficient opportunities can help learners achieve the intended learning outcomes. The practical, gradual, and feedback-based structure of the Web 2.0 training may therefore have contributed to participants' high perceptions of competence. The decrease in the standard deviation from the pretest to the posttest also indicates that participants' perceptions became more similar and generally higher after the intervention (Guskey, 2007). The Technology Acceptance Model (Davis, 1989) provides another possible explanation. According to this model, perceived usefulness and perceived ease of use are important factors in technology acceptance. The user-friendly characteristics of Web 2.0 tools (O'Reilly, 2007) and the opportunity to experience their instructional value during the training may therefore have strengthened participants' willingness to use these tools in teaching (Teo, 2009).

Previous studies have also reported positive effects of technology integration training on preservice teachers' self-efficacy. Tondeur et al. (2012) found moderate to strong effects of technology integration training, while Şentürk et al. (2024) reported moderate levels of self-efficacy among preservice teachers in developing content with Web 2.0 tools. The stronger effect found in the present study may be related to the practical structure of the training and its focus on user-friendly and creative Web 2.0 tools. Hew and Brush (2007) identified lack of technology knowledge and skills as one of the major barriers to technology integration. In this respect, the present study provides evidence that practice-oriented Web 2.0 training may help reduce this barrier. This interpretation is also consistent with previous research showing that lesson-planning practice and authentic technology experiences can strengthen preservice teachers' self-efficacy for technology integration (Tondeur et al., 2012; Tondeur et al., 2020).

The findings should nevertheless be considered in light of some limitations. First, the measures were based on self-report scales, and participants may have rated their competencies more positively than their actual performance would indicate (Kruger & Dunning, 1999). Second, high self-efficacy in using technology does not necessarily mean that these tools will be used effectively for pedagogical purposes in real classroom settings. Koehler and Mishra (2009) distinguish between knowledge of technology use and technological pedagogical knowledge. Therefore, teacher education should support not only technical skills but also the ability to decide how Web 2.0 tools can be used according to different student needs and instructional goals.

Overall, the findings show that structured and practice-oriented Web 2.0 training can have a strong effect on preservice teachers' perceived technical self-efficacy and competence in using Web 2.0 tools. At the same time, the findings indicate that the development of broader cognitive, social, and professional competencies may require longer and more varied learning experiences. Teacher education programs may therefore benefit from integrating Web 2.0 activities not as

isolated technology courses, but as part of continuous opportunities for instructional design, collaboration, reflection, and authentic classroom practice.

5. Conclusions

This study examined the effects of Web 2.0 tools training on preservice teachers' perceptions of digital competence, 21st-century skills, and competencies in the use of Web 2.0 tools. The findings revealed that the implemented training produced significant and strong effects, particularly on preservice teachers' perceptions of digital competence and their competencies in using Web 2.0 tools. Substantial improvements were identified especially in the dimensions of information technology competencies, competencies in designing instruction in digital environments, and Web 2.0 tools usage competencies. These findings suggest that practice-oriented and interactive Web 2.0 training constitutes an effective approach for enhancing preservice teachers' digital pedagogical competencies. Moreover, the strengthening of preservice teachers' self-efficacy perceptions regarding technology integration indicates that they may be able to employ digital technologies more consciously and effectively in their future instructional practices.

The findings also demonstrated that Web 2.0 training positively contributed to preservice teachers' 21st-century skills, particularly in the dimensions of information and technology literacy as well as entrepreneurship and innovation. However, the absence of statistically significant changes in the dimensions of critical thinking and problem solving, social responsibility and leadership, and career awareness suggests that technology-based training programs require longer-term, pedagogically enriched, and more holistic implementations in order to foster such higher-order and multidimensional skills. In this regard, it may be argued that teacher education programs should address Web 2.0 tools not only in terms of technical use, but also in an integrated manner incorporating digital ethics, critical thinking, problem solving, collaboration, and digital citizenship skills.

6. Recommendations

Based on the findings of the present study, several recommendations can be offered for teacher education programs and future research:

- Teacher education curricula could place greater emphasis on the pedagogical use of Web 2.0 tools by embedding practice-oriented activities into courses such as educational technologies, instructional design, and teaching methods. Rather than focusing primarily on the technical features of digital tools, these courses should encourage preservice teachers to explore how technology can be used to support meaningful learning and effective instructional design.
- Opportunities to develop Web 2.0 competencies should not be limited to preservice education. Providing ongoing professional development for both preservice and in-

service teachers may help sustain digital competence and strengthen teachers' confidence in integrating technology into their everyday instructional practices.

- The absence of significant improvements in critical thinking and problem solving, social responsibility and leadership, and career awareness suggests that these competencies may require different instructional approaches. Future Web 2.0 training programs could therefore incorporate inquiry-based learning, collaborative projects, digital citizenship activities, and authentic problem-solving tasks to promote the development of these more complex competencies.
- Future research should investigate the effectiveness of Web 2.0 training through experimental or quasi-experimental designs that incorporate comparison groups. Longitudinal studies are equally necessary to determine whether the competencies acquired during teacher education are sustained over time and successfully transferred to authentic classroom practice.
- Future studies may benefit from adopting mixed-methods approaches that combine quantitative findings with qualitative evidence gathered through interviews, classroom observations, reflective journals, and document analysis. Such research designs would offer a more comprehensive understanding of how preservice teachers develop technology-related competencies and how these competencies are actually enacted throughout the learning process.
- Extending this line of research to different teacher education programs, universities, and educational contexts would improve understanding of the contextual factors that shape the effectiveness of Web 2.0 training. Comparative studies may also provide valuable evidence for designing teacher education programs that integrate digital technologies in ways that respond to the needs of different educational settings.

7. Limitations

The current findings need to be considered in light of a few limitations. The first limitation concerns the study design. Because the study used a one-group pretest-posttest design, potential threats to internal validity, such as maturation or history effects, cannot be ruled out. The results cannot be definitively linked to the Web 2.0 training. Other events that occurred between pre- and post-intervention may have led to the changes observed.

Limitations of the study sample also restrict the interpretation of the results. The empirical evidence reported in this study was based on 33 preservice teachers, enrolled in the Faculty of Education in only one public university, who were accessed using a convenience sampling method. As such, the findings should not be generalized to other teacher education contexts without due caution.

Another important limitation concerns the assessment of the variables. All data used to assess the variables in the present study were obtained from self-report measures. While these measures can provide insight into teachers' perceptions of their classroom abilities, future research should corroborate these findings using other measures of competence, such as teacher observation, performance assessment, and teaching portfolios.

Additionally, the timing of the data collection is problematic. Because the posttest was administered immediately after the training, there is no way to know whether the results will last. Administering a follow-up test, say, several weeks later, would provide stronger evidence that the training is effective.

Finally, a six-week intervention may not have been long enough to observe differential effects of Web 2.0-supported learning across competencies. The intervention duration appeared adequate to improve competencies centered on using technology but was probably insufficient to observe effects on other, more advanced competencies, such as critical thinking and problem-solving, social responsibility and leadership, and career awareness. Additional time interacting with technology may have been needed for participants to develop their professional competencies to a measurable degree.

Acknowledgements

This article is based on the master's thesis prepared by the first author under the supervision of the second author.

The authors would like to sincerely thank all the students who voluntarily participated in this study for their valuable contributions. They also extend their sincere appreciation to the administrators and staff of the institution where the experimental intervention was conducted for their invaluable support and cooperation throughout the implementation process.

Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. Ethics approval for this study was obtained from the Social and Human Sciences Research and Publication Ethics Committee of Karamanoğlu Mehmetbey University by the decision dated April 26, 2024 (Decision No: 07-2024/151).

AI Use Statement

The authors declare that in the preparation of this manuscript no AI or AI-assisted technologies were utilized.

References

Anderson, C. (2012). Using Web 2.0 tools for feedback in the classroom. *Distance Learning, 9*(2), 21–25. https://doi.org/10.1108/DL-06-2012-0004

Anderson, P. (2007). *What is Web 2.0? Ideas, technologies and implications for education*. JISC Technology and Standards Watch. http://www.jisc.ac.uk/media/documents/techwatch/tsw0701b.pdf

Bacanak, A., Karamustafaoğlu, O., & Köse, S. (2003). Yeni bir bakış: Eğitimde teknoloji okuryazarlığı. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 14*(14), 191–196.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215. https://doi.org/10.1037/0033-295X.84.2.191

Bloom, B. S. (1968). *Learning for mastery* (Evaluation Comment, Vol. 1, No. 2). University of California, Los Angeles, Center for the Study of Evaluation of Instructional Programs.

Büyüköztürk, Ş. (2007). *Sosyal bilimler için veri analizi el kitabı*. Pegem Akademi.

Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2024). *Eğitimde bilimsel araştırma yöntemleri*. Pegem Akademi.

Chai, C. S., Koh, J. H. L., & Tsai, C.-C. (2013). A review of technological pedagogical content knowledge. *Educational Technology & Society, 16*(2), 31–51.

Choi, M. (2016). A concept analysis of digital citizenship for democratic citizenship education in the internet age. *Theory & Research in Social Education, 44*(4), 565–607. https://doi.org/10.1080/00933104.2016.1210549

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates. https://doi.org/10.4324/9780203771587

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications.

Çağır, S., & Yağcı, A. (2025). Üstün yetenekli öğrencilere eğitim veren öğretmenlerin Web 2.0 araçlarına yönelik görüşleri: Çocuk Üniversitesi örneklemi. *Uluslararası Ders Kitapları ve Eğitim Materyalleri Dergisi, 8*(1), 22–63. https://doi.org/10.53046/ijotem.1697366

Çelik, T. (2021). Web 2.0 araçları kullanımı yetkinliği ölçeği geliştirme çalışması. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 51*, 449–478. https://doi.org/10.9779/pauefd.700181

Çevik, M., & Şentürk, C. (2019). Multidimensional 21st century skills scale: Validity and reliability study. *Cypriot Journal of Educational Sciences, 14*(1), 11–28. https://doi.org/10.18844/cjes.v14i1.3506

Dağhan, G., Kalaycı, E., & Seferoğlu, S. S. (2011). Milli eğitim şuralarındaki teknoloji politikalarının incelenmesi. In *XIII. Akademik Bilişim Konferansı Bildirileri* (pp. 833–839). İnönü University. https://yunus.hacettepe.edu.tr/~sadi/yayin/AB11_Daghan-Kalayci-Seferoglu_MEB-Sura-Tek-Politika.pdf

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Fahser-Herro, D., & Steinkuehler, C. (2009). Web 2.0 literacy and secondary teacher education. *Journal of Computing in Teacher Education, 26*(2), 55–62. https://doi.org/10.1080/10402454.2009.10784633

Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency (TDC) framework. *Educational Technology Research and Development, 68*(5), 2449–2472. https://doi.org/10.1007/s11423-020-09767-4

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Ferrari, A. (2012). *Digital competence in practice: An analysis of frameworks*. Publications Office of the European Union. https://doi.org/10.2791/82116

Hainey, T., Connolly, T. M., Baxter, G. J., & Gould, C. (2014). A survey of academics' views of the use of Web 2.0 technologies in higher education. In Á. Herrero, B. Baruque, F. Klett, A. Abraham, V. Snášel, A. C. P. L. F. de Carvalho, P. G. Bringas, I. Zelinka, H. Quintián, & E. Corchado (Eds.), *International Joint Conference SOCO'13-CISIS'13-ICEUTE'13* (pp. 689–698). Springer. https://doi.org/10.1007/978-3-319-01854-6_70

Hatlevik, O. E., & Christophersen, K.-A. (2013). Digital competence at the beginning of upper secondary school: Identifying factors explaining digital inclusion. *Computers & Education, 63*, 240–247. https://doi.org/10.1016/j.compedu.2012.11.015

Jenkins, H., Purushotma, R., Weigel, M., Clinton, K., & Robison, A. J. (2009). *Confronting the challenges of participatory culture: Media education for the 21st century*. MIT Press. https://doi.org/10.7551/mitpress/8435.001.0001

Karakuş, İ., Sünbül, Ö., & Kılıç, F. (2022). Öğretmen adayı dijital yeterlik algısı ölçeği: Geçerlik ve güvenirlik çalışması. *Bayburt Eğitim Fakültesi Dergisi, 17*(35), 935–956. https://doi.org/10.35675/befdergi.883974

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60–70.

Krumsvik, R. J. (2011). Digital competence in Norwegian teacher education and schools. *Högre Utbildning, 1*(1), 39–51. https://doi.org/10.23865/hu.v1.874

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior, 45*(1), 79–122. https://doi.org/10.1006/jvbe.1994.1027

Leu, D. J., Kinzer, C. K., Coiro, J., Castek, J., & Henry, L. A. (2013). New literacies: A dual-level theory of the changing nature of literacy, instruction, and assessment. In D. E. Alvermann, N. J. Unrau, & R. B. Ruddell (Eds.), *Theoretical models and processes of reading* (6th ed., pp. 1150–1181). International Reading Association. https://doi.org/10.1598/0710.42

Li, Y., Garza, V., Keicher, A., & Popov, V. (2021). Predicting high school teacher use of technology: Pedagogical beliefs, technological beliefs and attitudes, and teacher training. *Technology, Knowledge and Learning, 26*(2), 385–409. https://doi.org/10.1007/s10758-018-9355-2

Mackey, T. P., & Jacobson, T. E. (2011). Reframing information literacy as a metaliteracy. *College & Research Libraries, 72*(1), 62–78. https://doi.org/10.5860/crl-76r1

Mahiroğlu, A. (2013). Öğretmenlik mesleği ve öğretmen yetiştirmede gelişmeler ve yenilikler. In Ö. Demirel & Z. Kaya (Eds.), *Eğitim bilimine giriş* (pp. 373–419). Pegem Akademi.

McMillan, J. H., & Schumacher, S. (2014). *Research in education: Evidence-based inquiry* (7th ed.). Pearson.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054. https://doi.org/10.1177/016146810610800610

Özdil, İ. (1979). *Eğitimsel iletişim ve eğitim teknolojisi*. Yüksek Teknik Öğretmen Okulu Matbaası.

Partnership for 21st Century Skills. (2009). *P21 framework definitions*. https://eric.ed.gov/?id=ED519462

Puentedura, R. R. (2006, August). *Transformation, technology, and education* [Presentation slides]. Hippasus. http://hippasus.com/resources/tte/

Ratten, V., & Usmanij, P. (2021). Entrepreneurship education: Time for a change in research direction? *The International Journal of Management Education, 19*(1), Article 100367. https://doi.org/10.1016/j.ijme.2020.100367

Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu* (Y. Punie, Ed.). Publications Office of the European Union. https://doi.org/10.2760/159770

Ribble, M. (2015). *Digital citizenship in schools: Nine elements all students should know* (3rd ed.). International Society for Technology in Education.

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers & Education, 128*, 13–35. https://doi.org/10.1016/j.compedu.2018.09.009

Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika, 52*(3/4), 591–611. https://doi.org/10.1093/biomet/52.3-4.591

Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning, 2*(1), 3–10.

Simões, L., & Gouveia, L. B. (2011). Social technology appropriation in higher education. *Journal of Social Informatics/Revista de Informatică Socială, 8*(16), 21–34. https://ris.uvt.ro/wp-content/uploads/2012/01/ris16_portugalia.pdf

Stanton, A. D., & Stanton, W. W. (2013). Digital natives or digital neophytes: Business student perspectives on course-based Web 2.0 applications. *Academy of Educational Leadership Journal, 17*(1), 119–137.

Şentürk, C. (2009). Eğitimde yeniden yapılanma ve yapılandırmacılık. *Eğitişim Dergisi, 23*(2).

Şentürk, C., & Yağcı, A. (2024). Matematik eğitiminde Web 2.0 araçları. In M. Dalkılıç & Ö. Soslu (Eds.), *Eğitim bilimleri alanında gelişmeler* (pp. 239–264). Platanus Publishing. https://doi.org/10.5281/zenodo.14580851

Şentürk, C., Yağcı, A., & Ecevit, M. O. (2024). Investigation of pre-service teachers' self-efficacy beliefs for practical content development with Web 2.0 tools. In Ş. Ay (Ed.), *Proceedings of the 12th International Conference on Social Sciences & Humanities* (pp. 202–239). IKSAD Publishing House. https://doi.org/10.5281/zenodo.12594483

Thiele, A. K., Mai, J. A., & Post, S. (2014). The student-centered classroom of the 21st century: Integrating Web 2.0 applications and other technology to actively engage students. *Journal of Physical Therapy Education, 28*(1), 80–93. https://doi.org/10.1097/00001416-201410000-00014

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development, 65*(3), 555–575. https://doi.org/10.1007/s11423-016-9481-2

Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education, 59*(1), 134–144. https://doi.org/10.1016/j.compedu.2011.10.009

Türk Eğitim Derneği. (2009). *Öğretmen yeterlikleri*. Adım Okan Matbaacılık.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press.

Wineburg, S., & McGrew, S. (2019). Lateral reading and the nature of expertise: Reading less and learning more when evaluating digital information. *Teachers College Record, 121*(11), 1–40. https://doi.org/10.1177/016146811912101102

Yağcı, A., & Şentürk, C. (2023a). Fen bilimleri (fizik-kimya-biyoloji) eğitiminde Metaverse. *EDUCATIONE, 2*(2), 262–288. https://doi.org/10.58650/educatione.1299434

Yağcı, A., & Şentürk, C. (2023b). Investigation of teachers' competencies in using Web 2.0 tools. In A. Bilgili (Ed.), *Proceedings of the Latin America 6th International Conference on Scientific Researches* (pp. 520–533). Academy Global Publishing House.

Yeşiltaş, E. (2016). Sosyal bilgiler öğretmen adaylarının sosyal ağ kullanım profillerinin belirlenmesi. *Turkish Studies, 11*(3), 2387–2406. https://doi.org/10.7827/TurkishStudies.9247

Zhao, Y. (2012). *World class learners: Educating creative and entrepreneurial students*. Corwin Press.