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Web 2.0 Tools in Chemistry Teaching: An Analysis of Pre-Service Chemistry Teachers' Competencies and Views

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ABSTRACT

This research aimed to explore the competencies of the pre-service chemistry teachers (PSCTs) to use Web 2.0 tools and their views on these tools in the context of chemistry teaching. A descriptive design was used. The participants were 27 PSCTs studying at the Department of Chemistry Education at a state university in Turkey. Data were collected through Web 2.0 Tools Usage Competence Scale and Structured Interview Form. The results demonstrated that the PSCTs were moderately competent in using Web 2.0 tools. The majority of them experienced these tools for the first time within the framework of this study and had no prior expertise. The interview results showed that the PSCTs thought that most chemistry subjects are difficult to comprehend due to their abstract sense, and that any subject can be taught more successfully using Web 2.0 tools to visualize it as a comics or animation. Considering the results, it was suggested that pre-service teachers and teachers could acquire knowledge and competencies in Web 2.0 technologies by organizing various projects, workshops and in-service trainings.

Kimya Öğretiminde Web 2.0 Araçları: Kimya Öğretmen Adaylarının Yeterlikleri ve Görüşlerinin Analizi

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ÖZET

Bu araştırma, kimya öğretmeni adaylarının Web 2.0 araçlarını kullanma yeterliklerini ve bu araçlara ilişkin görüşlerini kimya öğretimi bağlamında araştırmayı amaçlamıştır. Betimleyici araştırma tasarımı kullanılmıştır. Katılımcılar, Türkiye'de bir devlet üniversitesinin Kimya Eğitimi Bölümü'nde öğrenim gören 27 öğretmen adayıdır. Veriler Web 2.0 Araçları Kullanım Yeterliliği Ölçeği ve Yapılandırılmış Görüşme Formu aracılığıyla toplanmıştır. Sonuçlar, adayların Web 2.0 araçlarını kullanma konusunda orta düzeyde yetkin olduğunu göstermiştir. Adayların çoğu bu araçları bu çalışma çerçevesinde ilk kez deneyimlemişlerdir ve önceden herhangi bir uzmanlığa sahip değillerdir. Görüşme sonuçları, adayların kimya kavramlarının soyut anlamlarından dolayı anlaşılmasının zor olduğunu ve herhangi bir konunun bir karikatür veya animasyon şeklinde Web 2.0 araçları kullanılarak görselleştirildiğinde daha başarılı bir şekilde öğretilebileceğini düşündüklerini göstermiştir. Araştırma sonuçları göz önünde bulundurulduğunda, Web 2.0 teknolojileri konusunda çeşitli projeler, çalıştaylar ve hizmet içi eğitimler düzenlenerek öğretmenlerin ve öğretmen adaylarının bilgi ve yeterlilik kazanmaları önerilmiştir.

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1. Introduction

The diversity of tools used in educational environments and the presence of different stimuli in the learning process facilitates and supports teaching. In this respect, the integration of education environments, especially in the age of technology in every field, has resulted in the need for different Web-based tools to be prepared. Many students throughout the world have access to the internet and the advantages of technology. Furthermore, in educational environments, a teacher-centered approach has been replaced with a student-centered one. In these environments, students are active and engaged in the experiences they control their own learning. From this point of view, Web 2.0 applications, a key tool for information and communication technologies in new teaching environments designed for constructivist understanding, as a crucial tool for information and communication technologies in new educational settings built for constructivist understanding, play a role in supporting the student's active and participatory involvement in the learning process (Costa, 2014; Franklin & Harmelen, 2007).

Web 2.0 applications are among the technologies available in the learning process. These tools are defined as "online tools or software that can be used for personal and professional learning" (Fadini & Finardi, 2015: 604). Teachers can use Web 2.0 applications to improve communication, productivity, and collaboration while teaching (Brown, 2010; Greenhow et al., 2009). Educators now have a plethora of options for facilitating twenty-first-century learning settings because of the increased use of Web 2.0 technologies (Albion 2008; Bower, 2012; Unger & Tracey, 2014). These applications, which can be easily used both in the distance education process and in face-to-face education activities, offer many opportunities for teaching with their online nature (Bower et al., 2010). These applications are also successfully integrated into the education system of advanced societies, which allow individuals to work in groups and allow the flow of information between individuals (McLoughlin & Lee, 2007; Faboya & Adamu, 2017). Regarding the flow of information, Xiao (2008), in a research conducted on library services for users in the field of chemistry, stated that the use of Web 2.0 provides a collaborative model, and in this model, Web 2.0 acts as a catalyst in a chemistry reaction. As a result, Web 2.0 decreases user barriers, allows for novel ideas, and speeds up the process of linking consumers to library services and resources. The Web 2.0 tools, which are also common with rapid developments in internet technologies, enable interactive learning opportunities to design time, space-independent learning environments and content (Hurlburt, 2008; Hung & Yuen, 2010; McLoughlin & Lee, 2007; O'Reilly, 2007). Web 2.0 refers to a collection of web-based applications that facilitate collaboration, communication, and content sharing through simple user interfaces (Butler, 2012). Due to their knowledge-sharing and knowledge-building qualities, Web 2.0 tools offer a lot of promise to help students

develop 21st-century skills like communication and critical thinking, as well as digital literacy (Pascopella, 2008). Furthermore, using Web 2.0 tools in educational settings makes it easier and more accessible for students to acquire knowledge, collaborate in groups, socialize, and receive feedback (Alexander, 2006; Elmas & Geban, 2012; Horzum, 2010; McLoughlin & Lee, 2007; Thompson, 2007).

By means of Web 2.0 tools, which can be easily integrated into different courses in the field of education, the content of a course can be planned and class-specific learning environments can be created (Rich, 2008). It is supported by visual training environments that follow current trends in learning, social and professional communication, regardless of the workspace (Aikina & Zubkova, 2015). The more sensory organs one perceiving, the more physical reality it will perform. The common result of studies on Web 2.0 tools is that the integration of Web 2.0 tools enriches learning environments to enable sensory organs (Wang & Vasquez, 2012). Furthermore, several studies have shown that these technologies improve students' engagement in class and motivation, as well as their interest in and enjoyment of the course (Bünül, 2019; Gürsoy & Göksun, 2019; Masters & Barr 2009; Rhoads et al., 2013; Şad & Özer, 2019). In addition to these, the usage of Web 2.0 tools in educational environments is thought to benefit learning in terms of capturing students' attention, satisfaction with the process, creating a positive sense of commitment, problem-solving skills development, and knowledge sharing (Deebom & Amaso, 2017; Ergül Sönmez, & Çakır, 2021; Koehler, Newby, & Ertmer, 2017; Kutlu Demir, 2018).

Although individuals have frequently used Web 2.0 tools for personal usage, their integration into learning environments is still relatively new (Pan & Franklin, 2011). Although teachers are familiar with Web 2.0 tools such as blogs and wikis, they do not have the competence to use them in their classrooms due to the growth of Web 2.0 tools in today's environment (Pan & Franklin, 2011); therefore, in-service teachers who have actively use these tools can share their practical, real-world experiences on their own created accounts. In this way, teachers, who are non-active users, can be inspired by them to help students achieve curriculum goals, develop learning experiences and activities relevant to their field, apply them to their students, learn how to use a particular Web 2.0 application. Training programs are one way to stay relevant in the teaching profession, or to keep up with quickly evolving technologies. Students can use technology-assisted activities in higher education to create their own individualized learning environments (Kompen et al., 2019). The realization of this situation can be ensured by the fact that pre-service teachers are familiar and experienced with these technologies during their training process. Pre-service teachers who actively participate in these experiences will be able to perform technology-

based or technology-supported instructional activities in the future, and these experiences will be able to assist them through the practice (Gürsoy & Göksun, 2019).

Positive intentions of pre-service teachers on adopting technology and their digital competencies have been revealed to be important predictors of using possibilities and successful classroom integration (Geçgel et al., 2020; Myers & Halpin, 2002; Sadaf et al., 2016). As a result, they should be able to incorporate Web 2.0 tools into their educational procedures, utilise them, and, most importantly, integrate them into their respective fields (Çelik, 2021). Sadaf et al. (2016) conducted a two-phase investigation of pre-service teachers' intentions to integrate Web 2.0 technologies in their future classes, as well as the factors that influenced the actual use of Web 2.0 tools in their classrooms. The best determinants of pre-service teachers' intentions and actual usage of Web 2.0 tools in the classroom were perceived usefulness, self-efficacy, and student expectations, according to their findings. According to Bünül (2019), pre-service teachers believed that using Web 2.0 applications in the classroom will boost the effectiveness of instructional activities and the quality of teaching, be easy to use, and enrich the teaching environment. Gürsoy and Göksun (2019) stated in their study with pre-service teachers that the self-efficacy beliefs of them who use Web 2.0 applications, improved and their content development skills increased in terms of prejudice, satisfaction, awareness, fun, infrastructure problems, language problems and tool problems via these applications. Sadaf et al. (2012) investigated pre-service teachers' behavioral, normative, and control beliefs about their plans to use Web 2.0 technologies in their future classrooms in another study. Pre-service teachers agreed that incorporating Web 2.0 technologies into the teaching and learning environment was beneficial and had the potential to boost student learning, according to the findings of the study. Say and Yıldırım (2020) searched at pre-service teachers' opinions toward Web 2.0 tools in the classroom, and found that they had positive views toward the use of Web 2.0 tools for teaching, and that they benefited from usage areas like class teamwork, presentation preparation, and online educational applications. Gömleksiz and Pullu (2018), on the other hand, examined the effects of digital stories developed using Toondoo, one of the Web 2.0 tools, on the academic success and attitudes of pre-service teachers in the Information and Communication Technologies course. The impact of such tools of cognitive learning on permanence, connection, easy learning, active participation and consolidation, as well as sensory impact on dimensions like fun, motivation, confidence, and desire on the course, were noted in their research. In addition, they also determined that pre-service teachers encountered problems such as not being able to manage their time, focusing, learning the subject incompletely and working slowly on the computer while using Toondoo. Dobell (2013), on the other hand, studied at science teachers' abilities to function as subject

knowledge facilitators while using Web 2.0 tools to improve scientific course education in a research with them. According to the findings, science teachers at Montana's 14 largest high schools with 900 or more students rarely employ web 2.0 elements in the classroom for teaching. However, this study found that professional development is linked to teacher self-efficacy when it comes to integrating Web 2.0 technology into the classroom. In summary, the literature suggests that Web 2.0 technologies are valuable tools in the classroom, but it also reveals that teachers and pre-service teachers are lacking in this area and need to be trained.

On the other hand, a review of the literature reveals that most studies focus on pre-service teachers' intents and awareness of Web 2.0 technologies, while studies on their ability in using Web 2.0 technologies are limited. Cullen and Greene (2011) emphasized the importance of analyzing how intention translates into practice when pre-service teachers were offered the option of employing technology throughout their teaching. By measuring pre-service teachers' technological competencies, we can provide more comprehensive information on how pre-service teachers should use and apply new technologies, including Web 2.0 tools, in teacher training programs. In this context, these studies on Web 2.0 tools demonstrate that these applications should be expanded, and that study into the competencies and opinions of pre-service teachers in different fields should be conducted. Accordingly, this study discusses the competencies and opinions of pre-service chemistry teachers for application of Web 2.0 tools.

As is well known, learning chemistry is formidable for undergraduate students because it involves abstract concepts such as molecules and atoms. Chemistry often requires envisioning between the micro and macro worlds, which can be so complicated. Because some students have limited imaginative abilities and it is difficult for them to imagine the concepts or phenomena in chemistry (Cardellini, 2012; Hussein & Reid, 2009). Therefore, the application of new technologies such as Web 2.0 is needed, along with various methods and strategies, in order to learn more about chemistry in the process of chemistry teaching (Van Driel & De Jong, 2015: 113). For this, it is important that pre-service chemistry teachers who are familiar with Web 2.0 technologies are trained and able to integrate them into their teaching within a variety of activities using this technology. When studies in chemistry education were examined, we determined that these studies were limited to students in terms of participants and that there were no studies for pre-service chemistry teachers (Brownstein & Klein, 2006; Lawrie, 2016; Morais et al., 2017; Romero et al., 2019; Satpute & Bansode, 2016). The following are the research questions that this study is expected to answer:

a. To what extent are pre-service chemistry teachers' competent using Web 2.0 tools?

b. What are the thoughts of pre-service chemistry teachers on the applications they utilize with various Web 2.0 tools in the context of chemistry teaching?

2. Method

2.1. Research Design

This research was carried out within the framework of descriptive approach. Descriptive research is "aimed at casting light on current issues or problems through a process of data collection that enables them to describe the situation more completely than was possible without employing this method" (Fox & Bayat, 2007: 45). This design also allows for the combination of qualitative and quantitative data collection methods (Saunders et al., 2000). To collect data for this study, researchers employed interview and questionnaires.

2.2. Participants

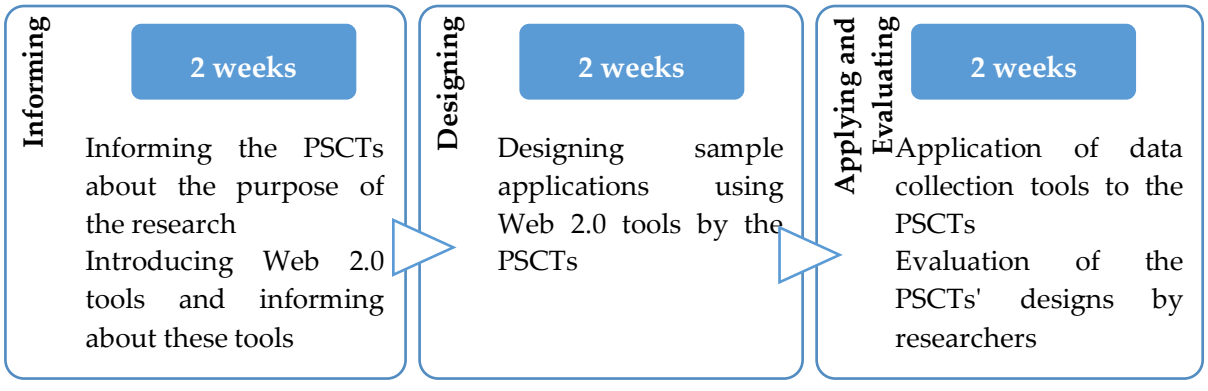
The research conducted 27 PSCTs (1 male, 26 female) studying at the Department of Chemistry Education at a state university in Turkey. The research was applied in the Chemistry Learning and Teaching Approaches course through distance education platform in third semester of 2020-2021 academic years. The course was 3 hours per week. Within the scope of this platform, synchronous lessons and course records were easily accessed, and various educational materials applied via online education.

2.3. Research Process

The research process is clearly described in three stages (Informing, Designing, Applying and Evaluating) in Figure 1.

Figure 1.

Steps of Research Process



The research process lasted for a total of six weeks (18 hours). During the research process, the PSCTs prepared original and individual studies on various Chemistry subjects by using three different Web 2.0 tools. PowToon, one of the Web 2.0 tools they used, is a cloud-based Web 2.0 tool that can create funny animated videos for business and education. It is an effective tool that can be used in distance education of students, especially in the learning process and that increase the participation of students in the classroom (Megawati & Utami, 2020).

Figure 2a.

A Sample Design on the Subject of History of Chemistry & Alchemy from PowToon App (PSCT-2)

Figure 2b.

A Sample Design on the Subject of Atom from Mindomo App (PSCT-10)

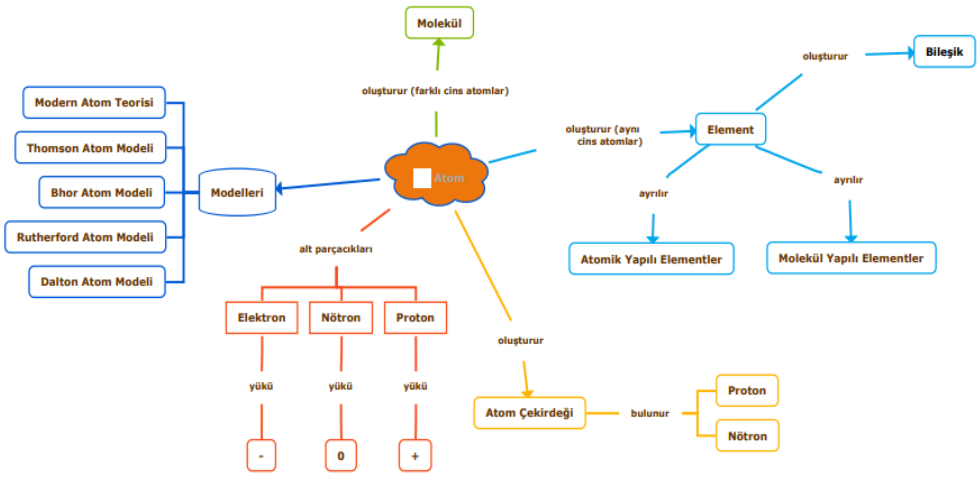
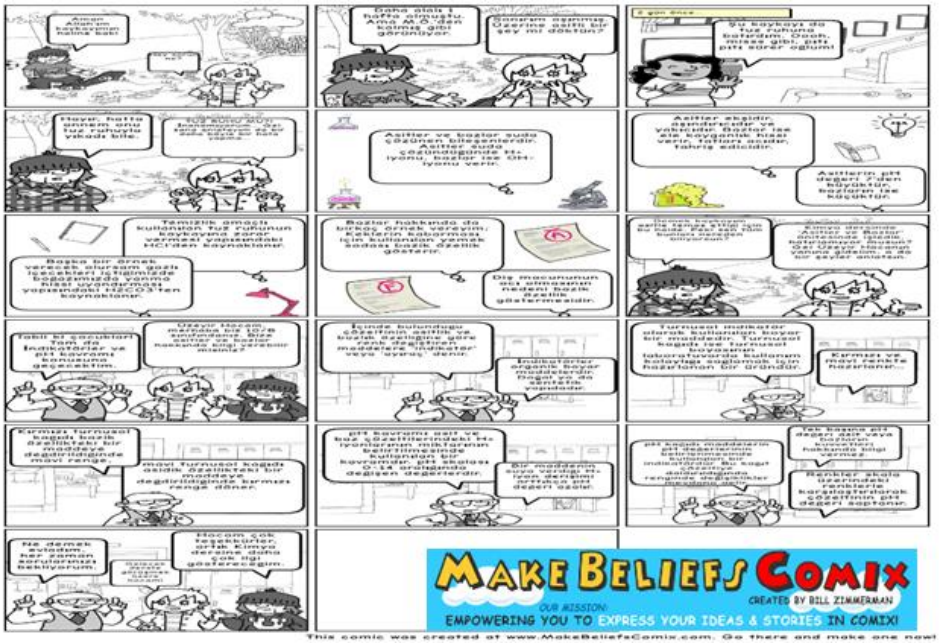


Figure 2c.

A Sample Design on the Subject of Acid-Base from the Make Beliefs Comix App (PSCT-23)



The second Web 2.0 tool, Mindomo, is an application tool used to create mind maps (Jbeili, 2013). It is a very useful mind mapping software that allows users to put their own ideas on paper (Záhorec, Hašková & Munk, 2021). Mind maps that can be saved on a computer can be backed up by storing them on a cloud storage server online. Third, the PSCTs applied the Make Beliefs Comix tool. Make Beliefs Comix is a Web 2.0 tool that can be used in the classroom environment by using site content writing, preparing cartoons, storytelling, and literature analysis. It can be used to encourage the creation of an autobiographical comic with the help of the creative ideas produced, and also to help students understand new words (Kohnke, 2020). Examples of Web 2.0 tools designed by the PSCTs during the research process are presented in Figure 2a, 2b and 2c.

2.4. Data Collection Tools

Two different data collection tools were used to collect qualitative and quantitative data. The detailed information about the tools was presented in Table 1.

Table 1.

Data Collection Tools

Quantitative Data	Qualitative Data
Web 2.0 Tools Usage Competence Scale • This scale aims to determine the competence of teachers and pre-service teachers in using Web 2.0 tools. • The scale developed by Çelik (2021) consists of a 5-point Likert-type total of 39 items and has a one-dimensional structure. The reliability coefficient of the scale was determined as 0.98. • As a result of the repeated reliability analysis in this research, the reliability coefficient of the scale [Cronbach's Alpha (α) coefficient] was found to be 0.94.	**Structured Interview Form** • Interviews were conducted through the Structured Interview Form developed by the researchers. • After the form was prepared, it was presented to an expert working in both qualitative research and chemistry education. In line with the expert suggestions, the form items were revised and given their final form. • The form consists of five open-ended questions in total. It was delivered to all of the study's participants (N: 27) on the basis of their willingness to participate.

2.5. Data Analysis

Descriptive statistical analysis was used for quantitative data and the scores from the scale presented as minimum, maximum, mean, standard deviation values. In addition, mean scores were calculated for each item of the scale.

The descriptive data analysis method, one of the qualitative research types, was used to analyze the qualitative data. Further, the responses of the PSCTs for each theme were anonymized and some examples of their statements were included in the results. The detailed information was presented in Table 2 for data analysis.

Table 2.

Data Analysis

Quantitative Data	Qualitative Data
Web 2.0 Tools Usage Competence Scale • SPSS 15.0 statistical analysis program was used for the analysis of the quantitative data obtained from the scale. • The scores of the scale items were subjected to descriptive statistical analysis and the results of the analysis were evaluated. • The minimum score that the pre-service teachers can get from the scale was 39, and the maximum score was 195. Accordingly, the interval coefficient was calculated as 31.2, and the group intervals of the total score were calculated as follows: ❖ Strongly Disagree (1): 39.0-70.1; ❖ Disagree (2): 70.2-101.3; ❖ Partially Agree (3): 101.4-132.5; ❖ Agree (4): 132.6-163.7; ❖ Strongly Agree (5): 163.8-195.0. Also the group intervals of the mean score were calculated as follows: ❖ Strongly Disagree (1): 1.00-1.80; ❖ Disagree (2): 1.81-2.60; ❖ Partially Agree (3): 2.61-3.40; ❖ Agree (4): 3.41-4.20; ❖ Strongly Agree (5): 4.21-5.00.	**Structured Interview Form** • The descriptive analysis technique was used in the analysis of qualitative data. In the descriptive analysis, the data obtained are systematically described according to the determined themes; these descriptions are explained and interpreted (Marvasti, 2004). The results are obtained by examining the cause-effect relationship (Nassaji, 2015). • The data were analyzed separately and individually by the researchers. Afterwards, these analyzes were compared and a common decision was reached. The similarity rate of the data set is important which was coded by the different coders (Patton, 2002). This similarity rate also determines the reliability of qualitative analysis. This similarity can be calculated using Miles and Huberman's formula, is called internal consistency and the consensus among the coders (Miles & Huberman, 1994). In this research, the consensus among researchers was determined as 96%.

3. Results

3.1. Results of Web 2.0 Tools Usage Competence Scale

Descriptive statistical analysis results of the scale scores were presented in Table 3. According to the data in the Table 3, the mean value was found to be 126.85. This value is in the partially agree group in the group intervals of the total score.

Table 3.

Descriptive Statistical Analysis Results of the Scale Scores

	N	Minimum	Maximum	Mean	Sd
Scale Scores	27	79	163	126.85	24.94

This finding shows that competence of PSCTs to use Web 2.0 tools is at a moderate level. The reason for this may

be due to the fact that the PSCTs did not have sufficient knowledge or practice these tools before this study. The mean values of pre-service teachers' responses to the scale items were presented in Table 4. According to the results in Table, among the 39 items on the scale, 4 items (10.26%) *strongly agree*, 11 items (28.20%) *agree*, 15 items (38.46%) *partially agree*, and the remaining 9 items (23.08%) disagreed.

Table 4.

Mean Score Results of Web 2.0 Tools Usage Competence Scale items

Item No	Scale Items	Mean
1	I can design learning environments with Web 2.0 tools independent from time and place. (e.g. Edmodo, Whiteboard, Google Classroom…)	2.78
2	I can prepare effective presentations with Web 2.0 tools. (e.g. Prezi, Powtoon, Buncee, Emaze…)	3.96
3	I can present knowledge and concepts on a topic with Web 2.0 tools in the form of a mind map. (e.g. Wisemapping, Pooplet, SpiderScribe, Gocongr…)	3.48
4	I can prepare animation applications with Web 2.0 tools. (e.g. Vyond, Voki…)	3.07
5	I can prepare digital boards with Web 2.0 tools. (e.g. Padlet, Bendspace, Lino ti…)	2.55
6	I can prepare posters with Web 2.0 tools. (e.g. Wordart, Sketch toy…like)	3.18
7	I can prepare cartoons with Web 2.0 tools. (e.g. Make Beliefs Comix, Toondoo…)	3.26
8	I can create digital stories with Web 2.0 tools. (e.g. Storyjumper, Storybird, Pixton…)	2.55
9	I can make virtual writing with Web 2.0 tools. (e.g. Wattpad, Blogger…)	2.74
10	I can add audio to stories that I produce with Web 2.0 tools. (e.g. Storyjumper..)	2.70
11	I can create a blog with Web 2.0 tools. (e.g. Blogger, Tumblr…)	2.85
12	I can prepare digital test with Web 2.0 tools. (e.g. Kahoot, Plickers, Socrative…)	3.48
13	I can create crossword puzzles with Web 2.0 tools. (e.g. Mentimeter, Flipquiz…)	2.96
14	I can create puzzles with Web 2.0 tools. (e.g. Pazillmaker, LearningApss...)	2.44
15	I can design an educational game with Web 2.0 tools. (e.g. Kahoot, Plickers, Socrati, Thinklink, LearningApss…)	2.48
16	I can prepare open-ended quizzes with Web 2.0 tools. (e.g. Kahoot, Socrative, Mentimeter, Quizziz…)	3.85
17	I can prepare a short answer quizzes with Web 2.0 tools. (e.g. Kahoot, Socrative, Mentimeter, Quizziz…)	3.92
18	I can create applications in-class assessment with Web 2.0 tools. (e.g. Kahoot, Socrative, Mentimeter, Quizziz…)	4.04
19	I can make the classroom environment fun and enjoyable with Web 2.0 tools.	4.78
20	I can prepare information posters with Web 2.0 tools. (e.g. Easelly, Visme, Creately…)	3.63
21	I can prepare infographics with Web 2.0 tools. (e.g. Pictochart, Venngage…)	2.44

22	I can design augmented reality activities with Web 2.0 tools. (e.g. Quiver, Morfo, Urasma…)	2.30
23	I can manage distance learning activities with Web 2.0 tools. (e.g. Moodle, Adobe Connect…)	2.44
24	I can edit my photos with Web 2.0 tools. (e.g. Gimps, Photostory, OpenShot…)	3.26
25	I can create movies with Web 2.0 tools. (e.g. Mowimaker, Photostory…)	2.44
26	I can edit my videos with Web 2.0 tools. (e.g. Mowimaker, Photostory, Safeshare, Filmora…)	2.96
27	I can remove the spam plugins from my videos with Web 2.0 tools. (e.g. Safeshare…)	2.44
28	I can record audio with Web 2.0 tools. (e.g. Vocaro….)	2.85
29	I can add video to mind maps I created with Web 2.0 tools. (e.g. Wisemapping, Poplet…)	2.96
30	I can add sound to mind maps I created with Web 2.0 tools. (e.g. Wisemapping, Poplet)	2.74
31	I can add a picture to mind maps I created with Web 2.0 tools. (e.g. Wisemapping, Poplet…)	3.30
32	I can add text to mind maps created with Web 2.0 tools. (e.g Wisemapping, Poplet…)	3.67
33	I can use applications I created with Web 2.0 tools in-class activities.	4.59
34	I can provide student participation in courses with Web 2.0 tools.	4.37
35	I can make the course fun using the applications I created with Web 2.0 tools.	4.59
36	I can design a course with Web 2.0 tools.	3.92
37	I can prepare Riddle activities with Web 2.0 tools. (e.g. Riddle..)	3.52
38	I can create surveys with Web 2.0 tools. (e.g. Survey, Monkey, Jetanket…)	3.52
39	I can participate in a discussion with Web 2.0 tools.	2.70

When the items of the scale were evaluated separately, four items (19, 33, 34, 35) in the group of strongly agree indicated that the PSCTs (10.26%) confirmed to ensure student participation in the classroom and make their activities fun in their course by using Web 2.0 tools. Eleven items (2, 3, 12, 16, 17, 18, 20, 32, 36, 37, 38) in the group of agree also showed that most PSCTs (28.20%) agreed with that they can make in-class assessments, prepare effective course materials, and benefit from these tools in their further course plans by using Web 2.0 tools. Fifteen items (1, 4, 6, 7, 9, 10, 11, 13, 24, 26, 28, 29, 30, 31, 39) in the group of partially agree were about the use and properties of different tools. Since pre-service teachers' competence in the usage of Web 2.0 tools found at a moderate level, it was expected that partially agree scores were also determined in these items related to the use and the properties of different Web 2.0 tools. Nine items (5, 8, 14, 15, 21, 22, 23, 27, 38) in the group of disagree indicated that the PSCTs were not experienced on the related Web 2.0 tools in these items. This finding means that the PSCTs were not acquainted with these Web 2.0 tools and they did not know how to use them for learning.

3.2. Results of Structured Interview Form

Table 5 showed the results of the content analysis of the Structured Interview Form which was used to identify the views of the PSCTs on the context of the Web 2.0 tools in chemistry education in the study in terms of knowledge, competency, teaching, designing course plans and usefulness.

Table 5.

Content Analysis of the PSCTs' Views on Web 2.0 tools

Main theme 1: Preliminary Knowledge on Web 2.0 Tools	**f**	**%**
Sub-themes:	27	100
Basic knowledge	3	11
No idea	24	89
Main theme 2: Usage Competence of Web 2.0 Tools	**f**	**%**
Sub-themes:	27	100
Foreign language	10	37
Simplicity	8	29.6
Practicality	5	18.6
Inexperience	4	14.8
Main theme 3: Chemistry Teaching through Web 2.0 Tools	**f**	**%**
Sub-themes:	27	100
Modern education tool	9	33.3
Concretization of concepts	9	33.3
Increasing visualization	6	22.2
Associating chemistry concepts	3	11.2
Main theme 4: Designing a Chemistry Course Plan including Web 2.0 Tools	**f**	**%**
Sub-themes:	27	100
Make classroom environment fun and enjoyable	10	37
Connection with daily life	6	22.2
Permanent learning	6	22.2
Summarizing the subject	5	18.6
Main theme 5: Usefulness of Web 2.0 Tools in Chemistry Education	**f**	**%**
Sub-themes:	27	100
Depends on creativity	9	33.3
Different properties of tools	7	25.9
Contents of chemistry subjects	7	25.9
Experimental activities	4	14.9

The main themes as a result of the content analysis of five interview questions and the sub-themes related to the main themes were presented by calculating the frequencies and percentages. The responses of the PSCTs to the question about their preliminary knowledge of Web 2.0 tools were mostly determined as no idea (89.0%). In the responses except of them, some of the PSCTs (11.0%) stated that they knew Web 2.0 within the scope of the Instructional Technologies Course and used the tools in their social accounts before:

> "I had no idea they were referred to as Web 2.0 tools. Prior to this study, I used social media, WordArt, Khan Academy, Google Forms, and Bitmoji.." (PSCT-22).

> "I have a blog account that is completely anonymous. It's a Twitter account that I occasionally use on a daily basis to share articles on books I've read and places I've visited." (PSCT-20).

The responses of the PSCTs with regard to usage competence of Web 2.0 tools focused on the fact that the language of use in the tool properties was mostly in a foreign language (37.0%), and they had inexperience (14.8%) because they used such tools for the first time.

> "I don't consider myself competent for now because I've never heard of various Web 2.0 tools, so I don't know how they are used. But I'm confident in my ability to learn quickly." (PSCT-2).

> "I don't think of myself as either incompetent or successful." Because I'm still learning how to utilize these tools, but I noticed that with a little thought, I could make a great job." (PSCT-10).

However, the pre-service chemistry teachers added to their statements that they could overcome this inexperience by using Web 2.0 tools more frequently later on and by examining their features in more detail in their prospective studies.

> "Web 2.0 tools are simple to comprehend and use. But I need to work on improving myself so that I may gather experience and put it to good use in the future." (PSCT -4).

> "I had no idea how to utilize the tool (PowToon) until I started using it." I watched several online videos on how to use it, and they were quite helpful. I'm satisfied with myself. I can easily use it; in fact, after learning this program, I utilized it again while writing another work." (PSCT-8).

In the statements of the pre-service teachers, themes such as Simplicity (29.6%) and Practicality (18.6%), which are among the important usage properties of Web 2.0 tools, emerged. Within the scope of the usage competence of Web 2.0 tools main theme, it has been seen in the statements that the PSCTs stated that as they continue to apply these tools, they will gain practicality, and this will increase their competency:

> "I encountered some difficulties working with Web 2.0 apps, but that will not prevent me from employing them in the future. I can improve myself, even if I use it many times in teaching environments, I can become familiar and I can gain practice." (PSCT-7)

> "The reason I had difficulty using Web 2.0 applications was that I did not have enough knowledge to use information technologies. I was able to overcome this deficiency with the Information Technologies course and similar courses that I attended at the university, but I thought that I could not develop myself enough yet. Since I began using Web 2.0 applications and similar applications (animation preparation programs, etc.), I improved myself a bit as I tried different practices." (PSCT-13)

After the study process where they had experience using Web 2.0 tools, the pre-service chemistry teachers expressed in their responses that these tools can be used effectively in Chemistry teaching. According to their responses, a subject that is difficult to learn can be presented in an organized manner and in a structure that makes it easier for students to remember, with an instruction in which these tools are used.

> "They can be quite effective in chemistry teaching if used properly." When appropriate, using the Make Beliefs Comix tool to create comics on a difficult-to-remember subject might assist students in learning the material more readily. With the help of the PowToon application, the course presentation can be more effective. For efficient learning, it is critical to employ instruments that appeal to the sense of vision. The usage of Web 2.0 tools can help students visualize course materials more effectively." (PSCT-10).

In addition, it drew attention to the pre-service teachers' responses (33.3%) that Web 2.0 tools were seen as modern educational tools that can be used during learning. From the answers of the pre-service chemistry teachers, it was revealed that they had the perception that depending on the characteristics of the tools, they could be effective in concretizing (33.3%), associating (22.2%), and more visualizing (11.2%) chemistry concepts.

> "An effective chemistry teaching can be conducted with Web 2.0 tools. Today's students are a generation that uses technology efficiently and wants us to use it too. We can make the classroom environment more fun and efficient by using different and interesting Web 2.0 tools. Lectures should not be taught only verbally and in writing. Chemistry is difficult for most students. The reason for this is that there is no information that we can hold with our hands and see with our eyes. But with these tools, we can make chemistry visible and concrete, if not tangible." (PSCT-4).

While designing the course plan in Chemistry education, the PSCTs stated positive opinions that the use of Web 2.0 tools can make the classroom environment fun and enjoyable (37%), connect the subjects with daily life (22.2%), attain permanent learning (22.2%) and help the subjects to be learned more easily in summary (18.6%):

> "We animate a chosen topic about chemistry using PowToon app. We can present the animated video we created with speech bubbles; a study that will make our students feel as if they lived in that time. Briefly, every application we use will be applications that will provide us to attract the student to the lesson. Thanks to this, we will be able to make even the most difficult chemistry subjects' fun and gain more active students in the classroom." (PSCT-16)

> "I can do similar study again on any chemistry topic. Even a memorable Chemistry virtual summary book can be made using these Web 2.0 tools. It would be a very interesting and convenient application. And with the combination of all these tools, even better results can come out."(PSCT-26).

The pre-service chemistry teachers also explained their suggestions for how to use different Web 2.0 tools including them in their future course plans. Some examples of their statements on the use of Web 2.0 tools in the course plans are as follows:

> "First of all, I create a concept map with Mindomo on the subject of the atom. Then I prepare a presentation where I will explain the atom, atomic models, and periodic systems. I include my concept map in the appropriate place on my presentation. I add animated videos with PowToon to parts of the presentation. In the introduction to the subject of the atom, I would create cartoon animations of the scientists Dalton, Thomson, Rutherford, and Bohr, who had worked on atomic models, with Make Belief Comix, create speech bubbles and give information about the subject. I would also place these animations in the appropriate place in my presentation" (PSCT-2).

> "I can design a chemistry course with Web 2.0 tools. I use the Edmodo application to have my classroom also have a virtual classroom. Today, most secondary school students have a smartphone. I share notes, interesting and motivating videos from this application. I can explain a subject using Web 2.0 tools. Through the Storyboard That program, I design a story that deals with the content of the course. We evaluate this story together with the students. Then I prepare questions for this story from the Kahoot app. We divide students into groups and answer these questions. Then I ask the students to prepare a concept map. I present the concept map that I prepared beforehand and they compare it with their own. In this way, I can teach an enjoyable and productive lesson." (PSCT-4).

Within the scope of the usefulness of Web 2.0 tools in chemistry education, most of the PSCTs (33.3%) thought that the use of these tools depended on creativity. This shows that they believe that the integration of many and

various Web 2.0 tools into learning environments can enrich their learning environments. At the same time, some of the PSCTs (25.9%) stated that these tools can be adapted to teaching any subject due to their different properties (e.g. characters, picture and video sharing, background, font, color).

> "Actually, it is suitable for any chemistry subject. We need to think and be creative. There are many applications under the name of Web 2.0. They can be used on many subjects notwithstanding the same app. For example, we can explain the subject through cartoons and evaluate it with the questions we have prepared using Web 2.0 tools." (PSCT-4)

> "I agree. Because the chemistry education is a practical science and I think it is beneficial to use lots of visuals to understand this science. For example, having students observe a laboratory experiment in the form of animated video will speed up their learning, or making a concept map on a subject will ensure the integrity of the subject in the minds of the students. Therefore, I think that using Web 2.0 tools in every subject of the Chemistry course will be appropriate and beneficial in terms of enriching the learning environment." (PSCT-23)

Considering the content of chemistry subjects, it was revealed from the statements of the PSCTs (25.9%) that the use of these tools in verbal subjects would be beneficial, but these tools were not suitable in numerical subjects. In addition, some of them (14.9%) stated that the use of these tools for subjects that require lab experiments would be limited. From the point of view of chemistry education, this shows that the PSCTs want to integrate Web 2.0 tools into their classes, but they cannot achieve this integration in all subjects and especially in lab experiments.

> "No, of course, it is not suitable for every chemistry subject. As I said, the use of Web 2.0 tools can be effective in visual matters. However, Web 2.0 tools may be insufficient, as some subjects can be taught verbally or through practical expression." (PSCT-11)

> "These types of applications are not suitable for every chemistry subject. While some subjects require experiments, it would be more accurate to explain some subjects by means of narration. I think that it would not be appropriate for teaching the subject to explain the content using cartoons on chemistry topics that I will teach by experimenting. I think it would be effective if such applications were used to draw the attention of students to the subject, which will be told for the first time." (PSCT-13)

4. Discussion

The integration of technology into educational environments has led to widespread use of the internet and various Web tools in these environments. In their classrooms, teachers should be able to readily use these tools, follow developments and become successful users as technology tools can aid teaching. In this respect, the research examined the competence of the pre-service teachers, who are the teachers of the future, for using Web 2.0 tools, and their views on the use of these tools in the context of chemistry teaching as a result of their applications with various Web 2.0 tools.

The pre-service chemistry teachers need Web 2.0 tools to prepare effective course designs and tutoring materials in their future teaching experiences. In fact, many studies in the literature point to the fact that pre-service teachers who are trained with the competence to use Web 2.0 tools can easily apply these tools in terms of developing and enriching their course content (Elmas & Geban, 2012; Horzum, 2007; 2010; Kıyıcı, 2010; Thompson, 2007). According to the findings, the PSCTs agreed that using Web 2.0 technologies in the study process, they could create successful course materials (such as animation, comics, posters, and so on) and presentations. Avcı et al. (2019) stated that teachers want to use the most video-sharing websites, encoding and presentations in their educational environment. This shows that teachers believe that presenting or watching videos is sufficient for incorporating technology into the classroom. At this point, instructors and pre-service teachers should be aware of the pedagogical effectiveness of Web 2.0 tools in order to create successful presentations rather than merely watching a movie or making a presentation in the classroom (Albion, 2008).

Other results of the study showed that the PSCTs agreed that integrating Web 2.0 tools in the classroom would encourage active involvement and make learning more enjoyable. Similarly, it was revealed in the studies that students found science courses conducted by the usage of Web 2.0 tools to be more enjoyable (Arslan & Arı, 2021; Karadağ & Garip, 2021; Weller, 2013). Moreover, Punie and Cabrera (2006) stated that students who continuously utilize different Web 2.0 tools during their learning process will remain more active and enthusiastic in this process. The studies have also stated that the Web 2.0 tools will have a favorable impact on education and work life as well as for students becoming technology readers, active and participating individuals in their future lives (Costa, 2014; Franklin & Harmelen, 2007; Richards, 2010).

Another result was found out that pre-service chemistry teachers could also employ Web 2.0 tools for classroom measurement and evaluation. According to the studies, it is critical for pre-service teachers to obtain practice

with test preparation methods and to use Web 2.0 applications for online measurement and evaluation (Dönmez-Usta et al., 2020; Kokoç, 2019). Simultaneously, the results revealed that the PSCTs could use these tools as materials to aid in the development of their course plans, and that in this way; they could achieve successful and beneficial results in their classrooms. Parallel research results also emphasized that Web 2.0 tools made learning and teaching more successful (Okoro et al., 2012). In their study of Altıok et al. (2017), they demonstrated and instructed pre-service teachers on several Web 2.0 tools. In their results, they found that pre-service teachers' interest in Web 2.0 applications increased and that they gained new professional knowledge and skills that they could apply in the future. In keeping with this result, the PSCTs experienced utilizing three different Web 2.0 tools (PowToon, Make Beliefs Comix, and Mindomo) that they could readily apply in both online and face-to-face classes. By increasing similar activities, trainings and diversifying their content, the pre-service teachers' competencies in using these Web 2.0 technologies can be improved.

Web 2.0 apps are becoming more popular as teaching tools, especially as the use of online courses increase. However, most teachers and pre-service teachers do not have sufficient knowledge and competence about these technologies (Altıok et al., 2017; Dönmez-Usta et al., 2020; Lip, 2008; Kıyıcı, 2010; Redecker et al., 2009; Weyant & Gardner, 2010). Similarly, we found that the pre-service chemistry teachers had no prior knowledge of these practices before. This result is also consistent with the findings of the interview. In the results of the interview, the PSCTs claimed they did not consider themselves too adequate for the first time since they used these tools, but that their competencies would improve as they made practice. They are not qualified for different Web 2.0 tools that are out of the scope of the study process. In addition to using the tools in online courses, it is significant for pre-service teachers to obtain experience in Web 2.0 applications that will assist and enrich their teaching environment as well as in face-to-face courses (Erdoğdu & Şengül, 2021). Kıyıcı (2010) stated that the pre-service science teachers expect to use the Web 2.0 technologies they are familiar with in their teaching as well. According to Vona-Kurt (2017), university students stated that Web 2.0 technologies supported the teaching process in many ways, but lack of experience in using these tools, and that because of this, they could not use the opportunities offered by Web 2.0 tools sufficiently.

The present study examined the opinions of the PSCTs regarding the use of Web 2.0 tools in the context of chemistry education. Results have shown that they believed that using such technologies in chemistry teaching could make the learning environment more visualized, concretized abstract concepts, and that concepts could be associated with each other. Concordant with these results in their study Romero et al. (2019) found that the

application of Web 2.0 tools supported teaching and learning of basic concepts of organic chemistry in large enrolment groups. Uyulgan & Akkuzu (2018) used short videos for educational purposes in chemistry laboratories. In their results, they likewise revealed that the use of visual and animated learning tools in chemistry education provides a strong and persuasive learning for students. Also, in the results of the literature, it is stated that especially the use of Web 2.0 tools such as graphic organizers (e.g. concept map, cause-and-effect diagram, and mind map) will be effective in learning of concepts (Williams & Chinn, 2009). Fisher and Frey (2018) asserted that students will acquire the practice of visually organizing knowledge beyond the classroom walls and improve surface learning to deep learning when they construct graphic organizers independently or in group works. Furthermore, Prensky (2009) revealed that with Web 2.0 tools, students would participate in the educational environment with more sensory organs, allowing them to retain more knowledge and improve their cognition. We also found that in the current study results, the PSCTs thought that such Web 2.0 applications were modern educational practices and expressed that their use would become even more popular in the future. In this case, using Web 2.0 tools can help teachers and pre-service teachers, considering their positive contribution to teaching.

In addition to this result that Web 2.0 applications could support teaching (Konstantinidis et al., 2013), the pre-service chemistry teachers also expressed that these applications were practical and useful in terms of their properties. These results were in alignment with the research of Hartshorne and Ajjan (2009), they emphasized that Web 2.0 technologies have positive properties in terms of usefulness, compatibility and ease of use, but it is important to make a student-centered instructional design in the use of such technologies. According to the findings of the interview, the PSCTs might use Web 2.0 tools to create a concept map and summarize a chemistry topic with a concept map, as well as use comics and animations to make the topic more interesting and permanent. They also stated that with the use of such educational materials, they could associate chemistry topics with daily life. Byrne (2009) categorized many educational benefits of Web 2.0 technologies under four educational dimensions as productivity, motivation, learning and learning to learn, and stated that teachers could use more up-to-date and functional content in their lessons, and at the same time, they could easily give examples from daily life through current problems. Furthermore, the PSCTs noted that they might readily integrate any Web 2.0 technology to chemistry topics by utilizing the software's various characteristics (e.g. characters, picture and video sharing, background, font, color).

5. Conclusion and Recommendations

In this study, as a consequence of their applications with various Web 2.0 tools, the competency of pre-service chemistry teachers, who will be the teachers of the future, was investigated for using Web 2.0 tools, as well as their perspectives on the use of these tools in the context of chemistry teaching. The applications made by the PSCTs were limited to three different Web 2.0 tools (PowToon, Make Beliefs Comix, and Mindomo) in this study. Results on pre-service chemistry teachers' competencies to use Web 2.0 tools showed that they were moderately competent. The reason for this situation can be shown as the fact that the majority of them encountered these tools for the first time within the scope of this study and had no prior experience. The fact that the tools used in this study were limited to only three enabled the PSCTs to have more competence in terms of them. Outside these limitations, providing the pre-service chemistry teachers with opportunities to use more Web 2.0 tools will improve their competence to use them. Further studies that allow the use of diverse Web 2.0 tools can help to improve the pre-service chemistry teachers' awareness and competencies concerning these applications. Another shortcoming of the study is its limited sample size. These research can be replicated with more participants, and the outcomes can be assessed.

The study also indicated that the PSCTs thought Web 2.0 tools were appropriate for all chemistry subjects. Additionally, they claimed that most chemistry subjects are difficult to comprehend because of their abstract sense, and that any subject may be taught more effectively when visualized as a comics or animation via the use of Web 2.0 tools. Furthermore, we reported that the PSCTs have indicated that as they gain more experience with these tools, they can improve their competency. When all of these results are considered, teachers in chemistry education, who can install the appropriate educational software and use technology to improve quality and achieve success, are needed to guide their students. This requires the inclusion of technology-integrated learning activities and laboratory practices in chemistry teacher training programs on a regular basis. Additionally, teachers and pre-service teachers can acquire knowledge and competencies in these technologies through a variety of projects, workshops, and in-service training.

Ethical Statement

This study is original and we declare that we obeyed the scientific ethical rules and responsibilities in all study processes, within the framework of the ethical standards offered by COPE.

Conflict of Interest and Financing

We declare that there is no conflict of interest in our work and it is not economically supported by any institution or organization.

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