The Purposes and Justifications for Preferences of Web 2.0 Tools Used by Pre-Service Chemistry Teachers in Their Teaching Practices in Distance Education Environment

OPEN ACCESS

Volume: 11

Special Issue: 1

Month: January

Year: 2023

E-ISSN: 2582-1334

Received: 20.09.2022

Accepted: 25.12.2022

Published: 20.01.2023

Citation:
Gencer, S., Turan Oluk, N., Kadayıfçı, H., & Yalçın Çelik, A. (2023). The Purposes and Justifications for Preferences of Web 2.0 Tools used by Pre-Service Chemistry Teachers in their Teaching Practices in Distance Education Environment. *Shanlax International Journal of Education, 11*(S1), 61-75.

DOI:
https://doi.org/10.34293/education.v11iS1-Jan.5908

Sinem Gencer
Gazi University, Turkey
https://orcid.org/0000-0001-9902-7534

Nurcan Turan-Oluk
Gazi University, Turkey
https://orcid.org/0000-0002-5430-4507

Hakki Kadayıfçı
Gazi University, Turkey
https://orcid.org/0000-0001-5063-1853

Ayse Yalçın Çelik
Gazi University, Turkey
https://orcid.org/0000-0002-0724-1355

Abstract
Due to the COVID-19 pandemic, mandatory changes were required in the field of education, as in many other fields. One of these fields is a teacher training programme, which includes teaching practice. It has become of great importance that pre-service science teachers, who frequently include experiments in their teaching practices in face-to-face education, will carry out this process in online education. This process, experienced due to the COVID-19 pandemic, prompted pre-service science teachers to find something that could replace the wet labs. One of the solutions in this situation is for them to choose and use appropriate Web 2.0 tools in their online lab teaching practices. Therefore, the purpose of the study was to examine the Web 2.0 tools used by pre-service chemistry teachers in their online teaching practices in a distance education environment, the purposes of using these tools, and their justifications for preferences to use these tools. This study was conducted with 15 pre-service chemistry teachers. Data were collected via observations, a form filled out by the participants, and semi-structured interviews in this study. According to the results of this study, it was determined that the participants used 17 Web 2.0 tools during their online teaching practices. The findings highlighted that the most used Web 2.0 tools were Perculus+ chat, Google docs, and Quizizz. Moreover, it was determined that the participants used these tools for 21 different purposes such as drawing students' attention, getting hypotheses, and designing experiments. The results also indicated that the participants emphasised the ease of the Web 2.0 tool as a justification for the preference for almost all of the Web 2.0 tools they use, regardless of their purposes for using these tools. It is thought that the results can be used to show how to make online or face-to-face teaching practices in teacher training programmes by using Web 2.0 tools more effective in the future.

Keywords: Pre-Service Chemistry Teachers, Teaching Practice, Web 2.0 Tools, Distance Education

Introduction

Since chemistry is a laboratory-based course, it requires students to participate in laboratory activities. The main purposes of laboratory teaching are (i) to teach laboratory techniques, (ii) to teach scientific process skills, and (iii) to provide practical experience that combines classroom learning with the real world (Woodfield, 2005).

Since teaching laboratory techniques requires one-to-one interaction of students with laboratory equipment and materials, Woodfield (2005) states that the other two purposes are skills that are more appropriate to be acquired in environments specially designed for distance education.

Laboratories, where students gain hands-on experience, are the environments where they develop mental and psychomotor science process skills. Laboratory experiences that can be realised through distance education may not provide a sufficient contribution to the development of psychomotor skills as well as the learning of laboratory techniques (Woodfield, 2004). However, this does not mean that laboratory practices cannot be carried out with distance education. Because of the COVID-19 Pandemic we experienced in 2020-2021, many countries considered distance education as a compulsory choice and adapted the education processes to be carried out in the laboratory by considering these differences (Ray & Srivastava, 2020).

The ways of performing laboratory experiments remotely can be listed as (i) showing pictures, (ii) watching a demonstration experiment video, (iii) performing/watching a real-time demonstration experiment, (iv) performing/watching a demonstration experiment with a real-time data recording system, (v) students conducting experiments with materials from their homes, (vi) experiencing simulation and virtual laboratory environments, (vii) performing remote-controlled experiments (remote lab) (Babinčáková & Bernard, 2020; Böhmová Šulcová, 2007; Lu, So, Lee & Yeung, 2021). When these methods are examined, it is seen that information and communication technologies (ICT) are used intensively in distance laboratory teaching.

The pandemic has affected teacher training institutions in higher education as well as all levels of education. Although these institutions immediately switched to distance education with the pandemic, it has become a serious problem how to carry out training that includes practical courses such as laboratories, practical works and field works (Yesiloglu, Gencer, Ekici &I sik, 2021). In addition, the pandemic has given the message that pre-service teachers should also learn to conduct courses through distance education to be prepared for another possible uncertainty. Thus, with the pandemic, it has become a necessity for pre-service teachers to gain experience in distance education and learn to plan their education and training processes according to distance education (Azid, Shi, Saad, Man &Heong, 2022).

One of the ICT tools that can be used in the distance education process is Web 2.0 tools (Kidd, 2013; Romero, Vidal Espinosa & Ramírez Hernández, 2019). In studies on Web 2.0 tools, it has been determined that these tools positively affect student achievement (Özenç, Dursun & Şahin, 2020), helpstudents to develop positive attitudes towards the course (Orhan & Men, 2018), and provide opportunities for more social interaction in out-of-school environments (O'reilly, 2007). Web 2.0 tools, which allow reaching multiple users at the same time, can also be used in teaching activities by allowing users to change content, communication and collaboration (Barak, 2017). The most effective way to teach pre-service teachers to use Web 2.0 tools is to allow them to interact with these applications (Albion, 2008).

Due to the COVID-19 pandemic, as in other applied courses, it has become of great importance how to conduct laboratory method teaching courses remotely, a course in which pre-service chemistry teachers plan and implement laboratory teaching before service. How to teach remotely without losing many advantages arising from the characteristics of chemistry teaching in a wet laboratory environment constituted the primary problem of the pre-service teachers taking the methods course in which the study was conducted. As a way to overcome this problem, the pre-service teachers selected appropriate Web 2.0 tools and tried to use them effectively. In this environment, it became an important issue to investigate the characteristics of the Web 2.0 tools selected by the pre-service teachers.

In this study, pre-service teachers' use of the Web 2.0 tools provided by the university and the Web 2.0 tools they searched and selected by themselves were analysed. Answers to the following questions were sought in the research:

1. Which Web 2.0 tools do pre-service chemistry teachers use while practising distance education with experiments?
2. For what purposes do they use these Web 2.0 tools?
3. What are the justifications for preferring the relevant Web 2.0 tools?

This research serves as a guide to educators and pre-service teachers about the Web 2.0 tools that can be preferred in special situations such as pandemic or how to conduct practical courses in distance education applications.

Method

Research Design

As a result of the COVID-19 pandemic, how pre-service teachers who had to carry out their teaching practices through distance education carried out this process in which they assumed the role of a teacher for the first time emerged as a situation that needed to be investigated. The study conducted for this purpose is a case study. A case study is a type of qualitative research method that gathers detailed information about a special case which is subjected to an in-depth holistic analysis without any intervention and questions as to why and how are investigated (Creswell, 1994; Patton, 2002; Yin, 2009).

Participants

This study was conducted within the scope of the Teaching in Chemistry Laboratory course in a chemistry teacher training programme at a state university. Pre-service chemistry teachers were informed about the aim of the research, and they were informed about their right to leave the study at any time. 15 pre-service chemistry teachers were enrolled in the course. 13 female pre-service chemistry teachers (Ayla, Banu, Cansu, Defne, Emel, Ela, Fatma, Gaye, Sare, Seda, Sevgi, Sibel, and Zeynep) and two male pre-service chemistry teachers (Demir and Mete) volunteered to participate in the study. Pseudonyms were used instead of their real names to keep the participants' identities confidential in the current study. The participants were provided with a written consent form before the study began.

Context of the Study

Teaching in Chemistry Laboratory course is a course in the 7thsemester of the 8-semester teacher training programme. Within the scope of this course, pre-service chemistry teachers are expected to plan and realise a teaching that they will carry out in the laboratory by choosing one of the learning outcomes in the secondary chemistry curriculum. During these teaching practices, one of the pre-service teachers takes on the role of teacher, while their peers take on the role of students. This course is carried out four hours a week in face-to-face education.

After the universities decided to conduct courses through distance education due to the COVID-19 pandemic, this course was conducted online for 80 minutes through a virtual learning environment called Perculus+ used by the university. Perculus+ environment is a virtual classroom environment that allows the participation of many people online at the same time, has features such as file and screen sharing, live video and audio streaming, and messaging and can be accessed via PC, smartphone and tablet.

Data Collection Tools

In this study, three different data collection tools, (i) in-class observation notes made by the researchers, (ii) a written opinion form filled in by the participants, and (iii) semi-structured interviews with the participants, were used to determine the Web 2.0 tools used by the participants in online teaching applications, their purposes of use and preference tools.

In-Course Observation Notes: Participants' distance education teaching practices were observed by the researchers, and observation notes were created. Using these notes, the researchers created a list of the Web 2.0 tools used by the participants and their purpose of use. This list included the Web 2.0 tools used by the participants in their teaching practices and the purpose of use statements for these Web 2.0 tools.

Written Opinion Form: This form was filled in by the participants. In the written opinion form, the participants were asked to choose which Web 2.0 tools they used during their teaching practices and their purposes of use from the list determined

by the researchers and to explain their justifications for theirpreferences in writing. In addition, the participants were asked to add the Web 2.0 tools they use or the purpose of its use to their answers if it is not on the list. Participant responses in the written opinion form were analysed by the researchers, the responses were compared with the observation notes, and incompatible situations, if any, were determined.

Semi-structured Interviews: Semi-structured interviews were conducted online with all participants. In the interviews, both participant confirmation was received and incompatible situations were discussed and a consensus was reached. Thus, the data were finalised.

Data Analysis

Researchers' observation notes, participants' written statements, and semi-structured interviews were analysed using content analysis and the constant comparative method. Content analysis is a method that makes it possible for researchers to study human behaviour in an indirect way (Fraenkel, Wallen & Hyun 2012). The constant comparative method allows the researcher to compare units of data with each other to generate raw categories, eventually reducing these to conceptual categories that emerge into an overall framework (Ary et al. 2010).

In the data analysis process, firstly, the choices of the participants in the written interview form regarding the Web 2.0 tools they use and the purposes of use were examined and compared with the observation notes kept by the researchers, and the frequencies of which Web 2.0 tools and for which purpose were determined. Then, the justifications for the participants' preferences stated in the written opinion form were combined with their statements in semi-structured interviews. The data relating to the justifications for preference were analysed by two of the researchers using content analysis and constant comparative analysis. In this analysis process, firstly, raw codes were created by examining the participant statements. 30% of the raw codes and participant statements containing code examples were subjected to consistency analysis by the other two researchers. The agreement with one of the researchers who conducted the consistency review was calculated as 92% and the agreement with the other was calculated as 89%. Then, in a meeting where four researchers came together, a consensus was reached through discussions on all coding with inconsistencies. After the codes were finalised, the codes with common features were grouped under the relevant categories and themes. The findings were presented by including frequencies and supported by direct quotations. An example of the code-category-theme list used in the analysis of the data related to the participant's preference for the Web 2.0 tools is given in Table 1.

This study used long-term interaction (10 weeks) and data triangulation (written statements form, researchers' observation notes, and semi-structured interviews) for credibility. Consistency was achieved this way throughout the study. The reliability of the study was verified by a detailed descriptive model.

Table 1 An Excerpt from the Code-Category-Theme List used in the Analysis of the Data on Preference Materials

Participant statement	Code	Category	Theme
Ayla: The justification why I preferred Perculus+ chat was to have a better command of the lesson during my presentation (maintaining the command of the course), to get more answers (keeping students active) and to get back to them quickly (giving instant feedback).	Maintaining the command of the course	Classroom Management	Pedagogical Justifications
	Giving instant feedback	Assessment and Evaluation	
	Keeping students active	Learning / Teaching Process	

Emel: Quizzes interface was simple to use (ease of interface), and it was easy for me to prepare the questions and for the students to use the site (easy to use). It was easy to access the results at the end of the quiz (instant results). There was a scoring system offered by the programme (easy scoring), it was seen in which questions the students made mistakes in percentile, we could go back and look at the mistakes and evaluate them, it offered the opportunity to evaluate the mistakes immediately (giving quick feedback).	Ease of interface	Ease of the Programme	Programme-related Justifications
	Easy to use		
	Instant results	Assessment and Evaluation	Pedagogical Justifications
	Easy scoring		
	Giving quick feedback		
Demir: Tinkercad programme is very easy to use (easy to use). I chose this application because it is a programme suitable for my mother tongue (mother tongue compatibility). I used this application to show the 3D representation of the experimental materials to the students. It offers the opportunity to make 3D designs (possibility to design) and save them in the application, which gives the ability to continue the design later (recordability). The fact that it is free online (free of charge) and useful (easy to use) also led me to choose this application	Easy to use	Ease of the Programme	Programme-related Justifications
	Possibility to design	Programme Facilities	
	Mother tongue compatibility	Programme Features	
	Free of charge		
	Recordability		

Results

The results of the study were analysed under two headings in terms of (i) the Web 2.0 tools used by the participants during their distance education teaching practices and the purposes of using these tools and (ii) the justifications for their preferences.

It was determined that the participants used 17 Web 2.0 tools during their online teaching (Figure 1). The most commonly used Web 2.0 tools were Perculus+ chat, Google docs and Quizizz. WhatsApp, Perculus+ audio, Perculus+ camera and YouTube were also frequently preferred by the participants.

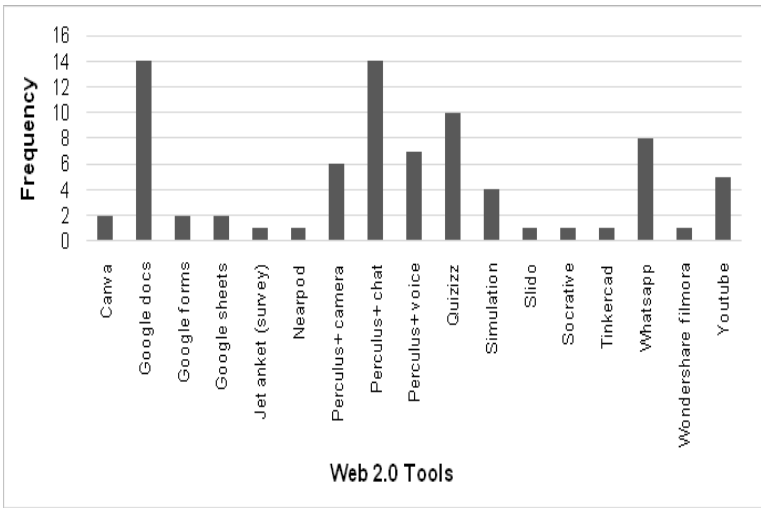

Figure 1 Web 2.0 Tools used by the Participants in Distance Education Applications and their Frequencies

The findings obtained for the purposes of use and justifications for preference of the Web 2.0 tools used are given in Table 2. The findings were presented with direct quotations.

Web 2.0 Tools Used and Purposes of Use

Firstly, the Web 2.0 tools used by the participants and their purposes of use were determined. As a result of the analysis of the data, it was determined that the participants used Web 2.0 tools for 21 different purposes such as attracting attention, getting hypotheses, and designing experiments. These purposes of use were grouped under five categories: introduction to the course, experiment, evaluation, communication and other elements, taking into account the processes related to the course (Table 2): (Table 2).

Table 2 Web 2.0 Tools used by the Participants and their Purposes of use

Processes	Purposes	Web 2.0 tools Used and Their Frequencies															
		Canva (n=2)	Google docs (n=14)	Google forms (n=2)	Google sheets (n=2)	Jet anket (n=1)	Nearpod (n=1)	Perculus+ camera (n=6)	Perculus+ chat (n=14)	Perculus+ voice (n=7)	Quizizz (n=10)	Simulation (n=4)	Slido (n=1)	Socrative (n=1)	Tinkercad (n=1)	WhatsApp (n=8)	Wondershare filmora (n=1)	YouTube (n=5)
Introduction to the course	Attracting Attention / Motivating		2						3									1
Experiment	Asking research questions		1										1					
	Receiving hypothesis/ predictions		10		1				3				1					
	Designing an experiment		1															
	Introducing experiment materials		3												1			
	Conducting the experiment (Data Collection)	1						5		5		3						4
	Recording data		12		1				1									
	Announcing/ discussing the results								2									
	Evaluating the data graphically				1													
	Elaborating											1						

Evaluation	Diagnostic evaluation		1				1		7				1					
	Process evaluation		3	1			1		1									
	Results evaluation		1								10			1				
	Product evaluation	1		1		1												
	Project evaluation					1												
	Self-evaluation			2														
Communication	Teacher-student communication						4	10	5			1			7			
	Communication between students								5	2						6		
Other elements	Video editing																1	
	Project design/ drawing	1																

Purposes of Use for Introduction to the Course Process

It was determined that the participants used Perculus+ chat (n=3), Google docs (n=2) and YouTube (n=1) Web 2.0 tools for the purposes of attracting attention and motivation during the introduction to the course in online teaching applications (Table 2). It was determined that only six of the participants used Web 2.0 tools for attracting attention and motivation. The remaining 13 participants did not use any Web 2.0 tools for this purpose.

Purposes of Use for the Experimental Process

It was determined that the participants used Web 2.0 tools for the purposes of receiving hypotheses/ predictions, designing the experiment, introducing the experimental materials, conducting the experiment (collecting data), recording the data, announcing/ discussing the result, evaluating the data graphically and elaborating (Table 2). In cases where students needed to record their ideas, such as receiving hypotheses/predictions (n=10) and recording data (n=12), it was found that Google docs were almost the only Web 2.0 tools used by the participants for these purposes. For the purpose of conducting the experiment (collecting data), five of the participants chose to have their students conduct the experiment and used Perculus+ camera and Perculus+ audio as Web 2.0 tools by having their students switch on their cameras and audio. The number of participants who used YouTube and Simulation for the same purpose was found to be four and three, respectively. It was determined that a small number of participants used Google docs, Tinkercad, Preculus+ chat, Google sheets and Simulation for the purposes of designing experiments, introducing experimental materials, announcing/discussing the results, evaluating the data graphically and elaborating.

Purposes of Use for the Evaluation Process

During the evaluation process, it was determined that the participants used various Web 2.0 tools for diagnostic evaluation, process evaluation, results evaluation, product evaluation, project evaluation and self-evaluation (Table 2). It was seen that Perculus+ chat (n=7) was mostly used for diagnostic evaluation and Google docs (n=3) was mostly used for process evaluation. It was determined that Google docs, Nearpod and SlidoWeb 2.0 tools were also used by a small number of participants for diagnostic evaluation. Similarly, Google forms, Nearpod and Perculus+ chat were also used by a small number of participants for process evaluation. For summative assessment, it was determined that most of the participants (n=10) used Quizizz and one participant each used Socrative and Google docs Web 2.0 tools for the same purpose. In the evaluation process, a small number of participants used Canva, Google forms and Jet survey Web 2.0

tools for product evaluation, project evaluation and self-evaluation.

Purposes of Use related to the Communication Process

Considering the communication process in the course, it was determined that the participants frequently used Perculus+ chat to ensure teacher-student communication (n=10) and communication between students (n=5). For these purposes, another Web 2.0 tools used alternatively by the participants was WhatsApp (n=8). It was also determined that some of the participants used Perculus+ camera, Perculus+ voice, and SlidoWeb 2.0 tools for communication purposes.

Purposes of Use of Other Elements in the Teaching Process

Under the title of other elements, video editing and project design/drawing purposes are included. It was determined that one of the participants used Wonder share film or aWeb 2.0 tool for video editing and another participant used Canva Web 2.0 tool for project design/drawing.

Justifications for Preference of Web 2.0 Tools Used

According to the research data, participants' justifications for preferring Web 2.0 tools were grouped under two themes: programme-related justifications and pedagogical justifications related to the teaching process. The categories under the themes of programme-related justifications and pedagogical justifications and the frequency distributions of Web 2.0 tools according to the categories are shown in Table 3 respectively. Below, the findings related to the justifications for preference for each theme are explained in detail and exemplified with direct quotations.

In the distance education process, online courses were conducted through the Perculus+ (ALMS) programme. Since different components of this programme depend on the participants' usage preferences, some components (chat, camera, audio) were also analysed. For example, while it was not their choice to switch on their cameras during their teaching, it was their choice to have their students switch on their cameras for different purposes. Participants who did this were coded as using the Perculus+ camera feature. Similarly, participants who had their students' voices switched on and those who preferred the chat section of Perculus+ during the course were coded as using Perculus+ voice and Perculus+ chat, respectively.

Justifications for Preferences Related to the Programme

When the justifications for preference related to the programme of the participants regarding their preferences for Web 2.0 tools were examined, it was determined that they were gathered under the categories of the ease of the programme, programme facilities, programme features, programme recognition (Table 3). Below, the justifications for preference related to the programme are detailed based on the programme by considering the frequency of use of the programme.

It was determined that most of the participants preferred Perculus+ chat on the grounds of easy to use, ease of access and multi-functionality. For Perculus+ camera and Perculus+ audio, easy to use, ease of access and multifunctionality of the programme were the justifications for preference. Examples of participants' statements for these categories are given below.

Ela: ...because everyone had easy access to Perculus+ camera and Perculus+ sound. (ease of access)

Demir: I chose Perculus+ chat because it is an area where I can easily get the opinions of the students. I chose this application because it is an area where everyone can participate and it allows them to express their prior knowledge about the subject. (ease of use, possibility of multiple use)

It is seen that almost all of the participants preferred Google docs (n=14), sheets (n=2) and forms (n=2) for programme-related justifications. These applications provide a practical opportunity for all students to record their data or opinions at the same time. Multiple uses, easy to use, and simultaneous use are the most frequently mentioned justifications for these applications. The multi-functionality of the program as it allows many functions such as creating tables, colouring, drawing graphs and the possibility of collecting data in a single file are also among the justifications commonly stated by the participants.

Table 3 Web 2.0 tools and justifications for preference

Justifications for preference	Web 2.0 Tools and Their Frequencies																
	Canva (n=2)	Google docs (n=14)	Google forms (n=2)	Google sheets (n=2)	Jet anket (n=1)	Nearpod (n=1)	Perculus+ camera (n=6)	Perculus+ chat (n=14)	Perculus+ voice (n=7)	Quizizz (n=10)	Simulation (n=4)	Slido (n=1)	Socrative (n=1)	Tinkercad (n=1)	Whatsapp (n=8)	Wondershare filmora (n=1)	Youtube (n=5)
• Justifications for preference related to the programme																	
• Ease of the Programme																	
• Easy installation																1	
• Easy to use	2	10	2		1		2	7	1	7		1		1	1	1	
• Ease of interface		1						1		1							
• Ease of access		4					1	6	1		1				1		4
• Programme Facilities																	
• Possibility of multiple use		13	1	1				7		3	2	1					
• Possibility to share files															1		
• Possibility to edit																1	
• Possibility of simultaneous use		8		1				3		2		1					
• Possibility to design	2													1			
• Possibility to collect data in a single file		5															
• Possibility of replay																	1
• Programme Features																	
• Multi-functionality of the programme	2	5	1	1			1	3	2	1							1
• Mother Tongue Compatibility		1								1				1		1	
• Free of charge														1		1	1
• Rich in content		1			1					1							3
• Being interesting/fun	1	1								3							
• Recordability		3												1			
• Programme Recognition																	
• Familiarity		2															
• Recognition		2	1					1		2	2				5		

• Pedagogical Justifications																
• Classroom Management																
• Maintaining the command of the course								1								
• Maintaining the continuity of the course								2								
• Maintaining order		4														
• Time Management		4						4	1	5		1				1
• Preventing systemic problems								3						1		
• Communication																
• Simultaneous communication								5	1					4		
• Effective communication							1	1	1					1		
• Easy communication								2				1		4		
• Continuous communication		1						1								
• Assessment and Evaluation																
• Giving instant feedback								1		3						
• Instant results										7		1	1			
• Student monitoring/follow-up		4						3								
• Easy scoring										2						
• Learning / Teaching Process																
• Enabling collaboration		3												1		
• Keeping students active		2					1	9	2		3					
• Learning outcomes relevance											1					
• Clarity		1							1							2
• Inclusion of the sub-microscopic dimension											1					1
• Compliance of purpose		4	2		1	1				3			1		1	
• Simulating a face-to-face learning environment							1	1	3	1						1

Mete: I had learnt how to use Web 2.0 tools such as Google docs and Google forms in a previous course. I preferred Google forms Web 2.0 tool because it is easy to use, the advantages it provides and I don't know any other survey preparation Web 2.0 tool. (Familiarity, easy to use, multifunctionality of the programme)

Most of the participants prefer Quizizz, Socrative, Jet survey and Nearpod for assessment purposes. The rationale for this is that the programme is easy to use, the application is interesting/fun because it contains visual and audio elements, and it provides multiple uses because it allows all students to log in at the same time.

Ela: Quizizz is an online programme in which all students can participate and everyone is assessed as equally as possible at the same time. I preferred it because it is easy to use (easy to use, possibility of multiple use, possibility of simultaneous use).

The participants preferred WhatsApp because it is a programme that is also used in their daily lives. In addition, it was determined that the participants preferred this Web 2.0 tool because of its easy to use, ease of access and the possibility to share files.

Demir: It is easy to access, … there is the possibility to send files... I preferred WhatsApp (ease of access, possibility to share files).

YouTube is mostly preferred justification for preference related to the programme. The justification for this is the ease of access as it is open to everyone and the rich in content as there is a wide variety of videos. In addition, it was determined that the participants preferred the simulations for conducting experiments because they provide the

opportunity for all students to use them at the same time (possibility of multiple use), because they can be easily accessed only with a given link (ease of access) and because it is an application they know how to use (recognition).

Sare: There are many videos of laboratory experiments on YouTube. It is also a free Web 2.0 tool that everyone can easily access (rich in content, easyto access, free of charge).

Fatma: I preferred to use the simulation toelaborate on the subject because it was an application I knew before (familiarity).

Some Web 2.0 tools used by only one or two of the participants during their distance education teaching practices were also identified. These are Canva, Slido, Tinkercad and Wondersharefilmora programmes. It was determined that these programmes were preferred only for programme-related justifications.

Cansu: Canva application is a very fun and very useful Web 2.0 tool. I chose it to show that it can be used in many areas. You can design and make a poster at the same time. In other words, I preferred Canva because it is a very wide application (interesting/fun, easy to use, multifunctionality of the programme, possibility to design).

Justifications for Pedagogical Preferences

When the pedagogical justifications of the participants regarding their preferences for Web 2.0 tools were analysed, it was determined that their justifications were gathered under the categories of classroom management, communication, assessment and evaluation, and learning/teaching process (Table 3). Below, pedagogical justifications are explained on a programme basis, taking into account the frequency of use of the programme.

It was determined that Perculus+ cam, Perculus+ chat and Perculus+ voice were preferred by the participants for various pedagogical justifications. The main pedagogical justifications for Perculus+ chat are keeping the student active by involving the student in the lesson, enabling simultaneous communication by allowing students to see each other's writings, and managing time by using the lesson time well. With Perculus+ voice and Perculus+ camera, it was determined that the participants tried to make the students participate in the lesson by turning on the camera and voice of the students, especially to make the learning environment similar to the face-to-face learning environment, and to enable other students to observe the students conducting experiments during the experiment.

Zeynep: My purpose of using thePerculus+ camera was to let the students see me and to create a friendly environment, to capture the closest position to face-to-face application (simulatinga face-to-face learning environment).

Ela: While performing the experiment, I wanted some students to be involved in the lesson by using Perculus+ camera and Perculus+ sound (keeping students active).

The participants prefer Google docs application mostly because it allows students to present their ideas as a whole, to use the lesson time effectively and to monitor student learning from the recorded data. Other pedagogical justifications for this Web 2.0 tool are continuous communication, enabling collaboration, keeping students active, clarity, and compliance of purpose.

Banu: I chose Google docs because it made it easier for me to follow the lesson and all students worked collaboratively. In this way, I did not lose time and did not stop communicating with the students. (student monitoring/follow-up, enabling collaboration, time management, continuous communication)

Participants prefer Quizizz, Socrative, Jet survey and Nearpod in terms of assessment and evaluation such as getting instant results, giving instant feedback and easy scoring because they allow them to see their students' answers instantly and intervene when necessary. In addition, the adjustment of answering times emerged as a pedagogical justification that led the participants to prefer these applications.

Zeynep: I think Quizizz is more formal than other applications and closest to the real exam. It sorts the results instantly according to the order of success, and students can answer quickly. (simulating a face-to-face learning environment, getting instant results, time management)

Simultaneous communication and easy communication are the most frequently mentioned pedagogical justifications for using WhatsApp. In addition, WhatsApp is also preferred for

preventing systemic problems, providing effective communication, enabling cooperation and being compliant of purpose.

Seda: Since there was no environment where we were together with the students, I had to communicate with all of them at the same time through a virtual platform to provide preparations before the lesson. For this, I preferred WhatsApp (simultaneous communication).

Simulation applications are preferred because they can provide the opportunity to keep students active, to be relevant to learning outcomes and to emphasise the particulate dimension of the events taking place in the experiment. In addition, it was determined that the participants preferred YouTube because the videos can be played and stopped at the desired speed and the subject can be made more understandable by including the sub-microscopic dimension.

Banu: I used YouTube to show the experiment in the microscopic dimension. I had the chance to show two events side by side in the video. Therefore, students could see both macroscopic and sub-microscopic dimensions. They saw the difference and similarities better (inclusion of sub-microscopic dimension, clarity).

It was determined that the preference of Canva, Tinkercad and Wondersharefilmora applications used by a small number of participants did not have pedagogical justifications, that is, these Web 2.0 tools were preferred only because of the features related to the programme. It was determined that Slido programme, which was used by only one participant, was preferred for pedagogical justifications such as time management, easy communication and getting instant results.

Defne: I used Slido application because it is easy to see the answers given at the same time and I can allocate time to the questions as I want. I also preferred this application because it is easy to interact between students and teachers (instant results, time management, easy communication).

Discussion and Conclusion

The pre-service teachers used a wide range of Web 2.0 tools while carrying out chemistry laboratory teaching activities. These tools helped them to actively involve their peers in the role of students at various stages of the experimental process, to enable students to collaborate and to evaluate the activities. This result shows that Web 2.0 tools provide appropriate learning environments for laboratory teaching (Yıldırım & Gürleroğlu, 2022).

It was determined that the participants showed the ease of use of the Web 2.0 tools as a justification for almost all of the Web 2.0 tools they used, regardless of their purpose of use. In general, it can be said that pre-service teachers tend to prefer user-friendly Web 2.0 tools (Elmas & Geban, 2012).

It is an important finding that very few of the participants preferred to conduct the experiment by turning on the cameras and voices of the students. The reluctance of students accustomed to face-to-face education to participate in distance education environments with video and audio during the pandemicis an important situation that reduces the effectiveness of teaching (Neuwirth, Jović &Mukherji, 2021). Some participants, on the other hand, incorporated experiments into their lessons in ways such as watching videos from YouTube. It is thought that the participants tended towards demonstration experiments using these programmes, especially because they were easily accessible, so the use of Perculus+ camera and Perculus+ sound remained limited.

It was determined that Perculus+ chat was used for different purposes for many stages of the course. It is an important finding that Perculus+ chat is used especially for the purposes that require the participation of students (e.g. diagnostic evaluation, hypothesis/predictions) during the introduction to the course process. The most important justifications for preferring this Web 2.0 tool are that it allows each student to participate at the same time and that it is easy. This situation suggests that the participants try to involve their students in the course process as much as possible and that they prefer the most practical way to do this. It was determined that the most frequently stated purpose of using this Web 2.0 tool was to provide both teacher-student communication and communication between students. Again, it can be said that written communication, instead of image and sound, emerged as the preferred way for

students in online environments (Neuwirth, Jović & Mukherji, 2021). The other Web 2.0 tool preferred for the same purpose is WhatsApp. As a result, it can be said that the participants attach importance to being able to reach all students at the same time and prefer these programmes that they consider effective to include communication in their lessons.

It was determined that the participants preferred Google docs the most among Google docs, sheets and forms Web 2.0 tools. Google docs is a preferred application because it is not necessary to install any programmes on the computer for its use and the storage is done in the cloud (Weller, 2013). It was determined that the participants frequently used this Web 2.0 tools because they wanted to receive and save the students' ideas in writing and return to the document when necessary. It can be said that the participants wanted to include scientific process skills such as recording data, determining variables, and drawing graphs in their teaching practices and preferred these Web 2.0 tools for this purpose.

It was determined that the most preferred Web 2.0 tool for assessment purposes during online teaching practices was Quizizz. Quizizz, as a game-based assessment and evaluation tool, stands out in online education (Darmawan, Daeni & Listiaji 2020; Ju& Adam, 2018). It is noteworthy that almost all of the participants met at a common point both for a single purpose (outcome assessment) and in terms of the Web 2.0 tools used (Quizizz). It was determined that the ease of use and the instant calculation of student scores by the programme were of great importance in the preference of this Web 2.0 tool. It is thought that Quizizz is preferred so much because the programme provides test scores without the need for the teacher to examine and score student answers and thus offers advantages to users in terms of time management.

It was also found that there are Web 2.0 tools that are commonly used by one or two participants during online teaching practices (e.g. Tinkercad). It was determined that these Web 2.0 tools were preferred because of some of their unique features, in other words, because they were suitable for the participant's current purpose. For example; Canva and Tinkercad programmes provide the participant with the possibility to design, Wondersharefilmora programme provides the possibility to edit the videos taken. For this reason, it can be said that a small number of participants preferred these programmes for very specific justificationsin online teaching applications.

As a result, pre-service chemistry teachers realised a laboratory activity they designed in the laboratory teaching method course by using many Web 2.0 tools. The pre-service chemistry teachers gained experience by using the tools that were used in previous face-to-face courses, that they had witnessed as students in online courses, that they had gained knowledge about by interacting with other pre-service chemistry teachers, and that they had been guided by the instructors of the course.

Based on the results of the study, it can be suggested that teacher training institutions, which focus on face-to-face science education, should include courses in their programmes in which pre-service teachers will receive formal training on the selection and use of Web 2.0 tools to contribute to the goals of training teachers suitable for increasingly digitalised teaching environments.

References

Albion, P. R. (2008). Web 2.0 in teacher education: Two imperatives for action. *Computers in the Schools, 25(*3-4), 181-198.

Ary, D., L. C. Jacobs, A. Razavieh, & Sorensen C. K. (2010). *Introduction to Research in Education*. 8th ed. Wadsworth, OH: Cengage Learning.

Azid, N., Shi, L. Y., Saad, A., Man, S. C., & Heong, Y. M. (2022). The Covid-19 pandemic: Web 2.0 tools as an alternative instruction for science in secondary schools. International *Journal of Information and Education Technology, 12*(6), 467-475.

Babinčáková, M., & Bernard, P. (2020). Online experimentation during COVID-19 secondary school closures: Teaching methods and student perceptions. *Journal of Chemical Education, 97*(9), 3295-3300.

Barak, M. (2017). Science teacher education in the twenty-first century: A pedagogical framework for technology-integrated

social constructivism. *Research in Science Education,47*(2), 283-303.

Böhmová, H., &Šulcová, R. (2007). *Chemistry experiment in distance education*. Problems of Education in the 21st Century, 2, 15-20.

Creswell J. W., (1994). *Research design: Qualitative & quantitative approaches*, Thousand Oaks, CA: Sage.

Darmawan, M. S., Daeni, F., & Listiaji, P. (2020). The use of quizzes as an online assessment application for science learning in the pandemic era. *Unnes Science Education Journal, 9*(3),

Elmas, R., & Geban, Ö. (2012). Web 2.0 tools for 21st-century teachers. *International Online Journal of Educational Sciences, 4*(1), 243-254.

Fraenkel, J., N. Wallen, & Hyun H. (2012). *How to Design and Evaluate Research in Education*. 8th ed. New York: McGraw-Hill.

Ju, S. Y., & Adam, Z. (2018). Implementing Quizizz as gamebased learning in the Arabic classroom. *European Journal of Social Science Education and Research, 5*(1), 194-198.

Kidd, W. (2013) Framing pre-service teachers' professional learning using Web 2.00 tools: positioning pre-service teachers as agents of cultural and technological change. *Professional Development in Education, 39*(2), 260–2.

Lu, C., So, W. W. M., Lee, Y. C., & Yeung, Y. Y. (2021). Exploring the problems of learning science in the English medium: a study on high school students' perceptions and attitudes in China. *Asia Pacific Journal of Education*, 1-16.

Neuwirth, L. S., Jović, S., & Mukherji, B. R. (2021). Reimagining higher education during and post-COVID-19: Challenges and opportunities. *Journal of Adult and Continuing Education, 27*(2), 141-156.

O'reilly, T. (2007). What is Web 2.0: Design patterns and business models for the next generation of software. *Communications & Strategies, 65*(1), 17-37.

Özenc, M., Dursun, H., &Şahin, S. (2020). The effect of activities developed with web 2.0 tools based on the 5E learning cycle model on the multiplication achievement of 4th graders. *Participatory Educational Research, 7*(3), 105-123.

Patton M. Q., (2002), *Qualitative research and evaluation methods*, 3rd Edition, Thousand Oaks, CA: Sage.

Ray, S., & Srivastava, S. (2020). Virtualization of science education: a lesson from the COVID-19 pandemic. *Journal of Proteins and Proteomics, 11*(2), 77-80.

Romero, R. M., Vidal Espinosa, L. O., & Ramírez Hernández, D. (2019). Organic chemistry basic concepts teaching in students of large groups at Higher Education and Web 2.0 tools. *Actualidades Investigativas en Educación, 19*(1), 281-313.

Weller, A. (2013). The use of Web 2.0 technology for pre-service teacher learning in science education. *Research in Teacher Education, 3*(2), 40-46.

Woodfield, B. F., Andrus, M. B., Andersen, T., Miller, J., Simmons, B., Stanger, R., ... & Bodily, G. (2005). The virtual ChemLab project: A realistic and sophisticated simulation of organic synthesis and organic qualitative analysis. *Journal of Chemical Education, 82*(11).

Woodfield, B. F., Catlin, H. R., Waddoups, G. L., Moore, M. S., Swan, R., Allen, R., & Bodily, G. (2004). The virtual ChemLab project: a realistic and sophisticated simulation of inorganic qualitative analysis. *Journal of Chemical Education, 81*(11).

Yesiloglu, S. N., Gencer, S., Ekici, F., &Isik, B. (2021). Examining Pre-Service Teachers' Views about Online Chemistry Laboratory Learning Experiences Amid the COVID-19 Pandemic. *Journal of Turkish Science Education, 18*, 108-124.

Yildirim, M., & Gurleroglu, L. (2022). A Teaching Suggestion in the COVID-19 Disease Pandemic Period: The Educational Website

Enriched by Web 2.0 Tools. *International Journal of Web-Based Learning and Teaching Technologies (IJWLTT), 17*(2), 1-17.

Yin R. K., (2009), *Case study research: Design and methods*, 4th Ed, Thousand Oaks, CA: Sage.

Author Details

Sinem Gencer, *Gazi University, Turkey,* ***Email ID****: sinemuner@gazi.edu.tr*

Nurcan Turan-Oluk, *Gazi University, Turkey,* ***Email ID****: nurcanturan@gazi.edu.tr*

Hakki Kadayifci, *Gazi University, Turkey,* ***Email ID****: hakki@gazi.edu.tr*

Ayse Yalcin-Celik, *Gazi University, Turkey,* ***Email ID****: ayseyalcin@gazi.edu.tr*