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Pre-service Chemistry Teachers' Knowledge and Experience with Web 2.0 Tools[1]

Kimya Öğretmen Adaylarının Web 2.0 Araçları ile İlgili Bilgi ve Deneyimleri

Ayse Zeynep SEN , Assist. Prof. Dr., Balikesir University, azeynepsen@balikesir.edu.tr

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Abstract. Web 2.0 tools consist of a series of internet-based applications that allow users to create and share content interactively across many different disciplines. In chemistry education, Web 2.0 tools are frequently used because they help concretize concepts that are difficult to grasp at the particle level, provide an interactive learning environment, encourage students to collaborate, and, most importantly, overcome time and space limitations by granting students access to resources from anywhere, at any time. This study focused on pre-service chemistry teachers (PCTs) and aimed to examine their knowledge and experiences with Web 2.0 tools. The study was conducted using a qualitative approach with 62 PCTs during the spring term of the 2023-2024 academic year. Data were collected through open-ended questions and interviews. The findings revealed that more than half of the PCTs had heard of Web 2.0 tools, especially Kahoot, and that they were mostly introduced to these tools through field education courses. When examining their views on the advantages and disadvantages of using Web 2.0 tools, it was found that they suggested fewer disadvantages compared to the advantages. The most commonly mentioned advantage was the tools' facilitation of learning, while the most common disadvantage was the need for technological equipment. Additionally, it was found that they referred to the potential for Web 2.0 tools to cause misconceptions in chemistry education as a possible disadvantage. It is recommended that future research focus on the knowledge and experiences of PCTs, particularly in relation to Web 3.0, which offers artificial intelligence support, and Web 4.0, which includes both artificial intelligence and augmented reality support, especially in the context of chemistry teaching and learning.
Keywords: Web 2.0 tools, Pre-service chemistry teachers, Chemistry teaching.

Öz. Web 2.0 araçları, kullanıcıların etkileşimli bir şekilde içerik oluşturmasına ve bu içeriği paylaşmasına olanak tanıyan bir dizi internet tabanlı uygulamadan oluşmaktadır. Kimya eğitiminde, Web 2.0 araçları; tanecik boyutunda kavraması güç olan konuları somutlaştırması, interaktif bir öğrenme ortamı sunması, iş birlikli çalışmaya fırsat tanıması, zaman ve mekandan bağımsız olarak herhangi bir kaynağa erişimi kolaylaştırması sebebiyle sıklıkla kullanılmaktadır. Bu çalışma, kimya öğretmen adaylarına (KÖA) odaklanarak, katılımcıların Web 2.0 araçlarına ilişkin bilgi ve deneyimlerinin incelenmesini amaçlamaktadır. Çalışma, 2023-2024 eğitim-öğretim yılı bahar döneminde 62 KÖA ile nitel bir yaklaşım benimsenerek yürütülmüştür. Veriler, açık uçlu sorular ve görüşmeler yoluyla toplanmıştır. Veriler analiz edildiğinde, KÖA'ların yarısından fazlasının Web 2.0 araçlarını ve özellikle Kahoot'u daha önce duyduğu, bu araçlardan çoğunlukla alan eğitimi dersleri yoluyla haberdar oldukları belirlenmiştir. Web 2.0 araçlarını kullanmanın avantaj ve dezavantajlarına dair görüşleri incelendiğinde önerdikleri avantajlara kıyasla daha az sayıda dezavantaj önerisinde bulundukları belirlenmiştir. En yaygın avantaj olarak bu araçların öğrenmeyi kolaylaştırıcı yönüne, en yaygın dezavantaj olarak da teknolojik donanım gerektirmesine değindikleri belirlenmiştir. Ek olarak kimya öğretimi açısından Web 2.0 araçlarının yanlış kavramaya neden olabileceği yönünü olası bir dezavantaj olarak dile getirdikleri saptanmıştır. Gelecekteki araştırmalarda, KÖA'ların özellikle kimya öğretimi ve öğreniminde yapay zeka desteği sunan Web 3.0 ve yapay zekaya ek olarak artırılmış gerçeklik desteği sunan Web 4.0 konusundaki bilgi ve deneyimlerine odaklanılması önerilmektedir.
Anahtar Kelimeler: Web 2.0 araçları, Kimya öğretmen adayları, Kimya öğretimi.

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Genişletilmiş Özet

Giriş. 21. yüzyıl becerilerinin geliştirilmesi, modern toplumun değişen ihtiyaçlarını karşılamada önemli bir rol oynamaktadır. İş yerinde, okulda ve sosyal ortamlarda başarılı olmak için gereken çeşitli yetkinlikleri içeren bu beceriler, bireylere hem çağın sunduğu fırsatları yakalamada hem de yine çağın getirdiği zorlukların üstesinden gelmede yardımcı olmaktadır (Öpengin & Elmas, 2023). Bu doğrultuda öğretmenlerin öncelikle teknoloji okuryazarı olmaları, ardından teknoloji entegrasyonu konusunda yetkin olmaları beklenmektedir. Web 2.0 araç kullanımı, öğretmenlerin teknolojik yetkinliklerinin sınıf içindeki yansımalarından birisi olarak gösterilebilir. Web 2.0 araçları; öğrenci ve öğretmenlerin çevrimiçi olarak iş birliği yapmasına, içerik alışverişinde bulunmasına olanak tanıyarak çevrimiçi etkileşimlerini daha dinamik ve ilgi çekici hale getiren internet tabanlı program ve platformlar olarak tanımlanabilir. Ayrıca, sosyal ağ oluşturma ve kullanıcı tarafından oluşturulan içerikler üzerinde çalışma imkanı sunarak proaktif bilgi paylaşımına fırsat tanırlar (Brodahl vd., 2011). Web 2.0 araçlarının özellikle kimya eğitiminde maddenin tanecikli yapısını somutlaştırma gibi avantajları olması nedeniyle mevcut çalışmanın amacı, kimya öğretmen adaylarının (KÖA) Web 2.0 araçlarına yönelik genel anlamda bilgi ve deneyimlerinin incelenmesi olarak belirlenmiştir.

Yöntem. Çalışma, "bir olayı, faaliyeti, süreci veya bir ya da daha fazla bireyi anlamayı içeren bir 'durum' veya sınırlı bir sistemin derinlemesine anlaşılmasını ortaya çıkaracak bir problem" (Creswell, 2002, s. 61) olarak tanımlanan durum çalışması modeli ışığında yürütülmüştür. Bu doğrultuda, araştırmada KÖA'ların Web 2.0 araçları hakkında ne ölçüde bilgi ve deneyim sahibi olduklarını belirlemek için katılımcıların görüşlerine yer verilmiştir. Katılımcılar, Türkiye'nin batısında yer alan bir devlet üniversitesinin kimya eğitimi ana bilim dalında öğrenim gören 62 KÖA'dan oluşmaktadır. Çalışmada veriler, açık uçlu soruların çevrimiçi doldurulması ve görüşmeler yoluyla toplanmıştır. Elde edilen verilerin analizinde betimsel analiz ve içerik analizi yöntemleri kullanılmıştır. Etik ilkelerin sağlanması amacıyla Balıkesir Üniversitesi Fen ve Mühendislik Bilimleri Etik Kurulu'nun 16.09.2024 tarihli toplantısında E-19928322-100-425420 numarası ile onay alınmış ve katılımcılara ait bilgilerin üçüncü kişilerle paylaşılmaması adına gerçek isimleri yerine takma isimler kullanılmıştır.

Bulgular Çalışmadan elde edilen verilerin analizi sonucunda, ilk olarak KÖA'ların genel anlamda Web 2.0 araçlarından haberdar oldukları belirlenmiştir. Öğretmen adaylarından Web 2.0 araçlarına örnek vermeleri istendiğinde, en sık verilen örneğin Kahoot olduğu görülmüştür. Devamında, Web 2.0 araçlarına dair bilgi ve deneyime hangi kaynaklardan ulaştıkları sorulduğunda, ilk sırada lisans derslerinin, ikinci sırada ise katıldıkları çalıştay/projelerin katkı sağladığı belirlenmiştir. Ayrıca, birçok lisans dersinde bu araçların kullanıldığı sonucuna ulaşılmıştır. Web 2.0 araçlarının kullanımının avantaj ve dezavantajlarına yönelik görüşleri sorgulandığında ise farklı sonuçlar ortaya çıkmıştır. Avantajlar konusunda birçok örnek verdikleri, durumu öğretmen ve öğrenci açısından ele aldıkları belirlenmiştir. Öğrenciler açısından öğrenmeyi kolaylaştırması ve bilgiye daha hızlı erişim sağlaması ilk sıralarda yer alırken, öğretmenler açısından ders işlemeyi kolaylaştırması ve önbilgiyi ölçmeyi kolaylaştırması gibi avantajlar öne çıkmıştır. Dezavantajları konusunda örnek vermekte zorlandıkları, hatta büyük bir kısmının Web 2.0 araçlarının herhangi bir dezavantajı olmadığına inandıkları belirlenmiştir. Ancak, az sayıda katılımcı; Web 2.0 araçlarının öğretmenler açısından da teknolojik donanımın yetersiz olması durumunda kullanımının mümkün olmaması, öğrencileri hazıra alıştırması, yanlış kavramalara sebep olması ve gibi olumsuz etkilerden bahsetmiştir.

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Tartışma ve Sonuç. Başlangıçta, katılımcıların Web 2.0 araçlarından haberdar olup olmadıklarına ve hangi araçlar hakkında bilgi sahibi olduklarına odaklanılmış ve genel olarak katılımcıların bu konuda bilgi sahibi oldukları belirlenmiştir. Üçüncü ve dördüncü sınıftaki KÖA'ların daha fazla bilgi sahibi olmaları, sınıf düzeyi ilerledikçe alınan ders türü ve sayısının artışıyla, farklı öğretim uygulamalarından haberdar olma olasılıklarının da artışıyla ilişkilendirilebilir. Ayrıca, öğretmen adaylarının farklı proje ve atölye çalışmalarına katılmalarının, aşinalıklarına olumlu katkı sağladığı düşünülebilir. KÖA'ların en sık verdikleri Web 2.0 aracı örneğinin, ölçme amacıyla kullanılan Kahoot olduğu görülmüştür. Ölçme, öğretimin zorlu bir boyutu olup etkin biçimde gerçekleştirilmediğinde, öğretmen öğretimin ne derece başarılı olduğunu görememekle birlikte sonraki öğretim süreçlerini yönlendirmekte de yetersiz kalabilir. Öte yandan, öğrencilerin klasik kağıt-kalem ölçme tekniklerini sıkıcı bulmaları sebebiyle öğretmenlerin farklı, eğlenceli, erişilebilir ve etkileşimli özelliklere sahip sonuç veya süreç odaklı ölçme tekniklerine başvurmaları fark yaratabilir. Bu beklentileri karşılayabileceği için Kahoot'un daha popüler bir seçenek olduğu söylenebilir. Ayrıca, bu çalışmada atölye çalışmaları, projeler ve lisans öğretimi gibi deneyimlerin Web 2.0 araçları konusunda katılımcılara katkı sağladığı eklenebilir. Öğretmen eğitimi programlarında öğretmen adaylarına Web 2.0 araçlarıyla teknolojik açıdan zengin deneyimler sunulması ile öğretmen adaylarının bu teknolojileri profesyonel yaşamlarına entegre etme olasılıklarının artabileceği söylenebilir (Tünkler (2021). Bu noktada lisans düzeyinde hangi derslerin öğretmen adaylarına Web 2.0 araçları konusunda katkı sağladığı sorusu akla gelmektedir. Katılımcıların, genel kültür ve meslek bilgisi derslerine kıyasla alan eğitimi derslerinde daha sık kullanıldığını ifade ettikleri sonucuna ulaşılmıştır. Web 2.0 araçlarının kullanımının, öğrenciler ve öğretmenler için birçok avantajı bulunmaktadır (Elmas ve Geban, 2012). Katılımcıların, Web 2.0 araçlarının öğrenci ve öğretmenler açısından avantajları konusunda bilgili oldukları belirlenmiştir. En sık ifade edilen avantaj, alan yazınıyla uyumlu olarak, Web 2.0 araçlarının öğrenmeye katkı sağlamasıdır (Balcı Çömez vd., 2022; Faizi vd., 2015). Katılımcılara göre, öğrenciler için bir diğer avantaj da bilgiye daha hızlı erişim sağlamasıdır. Bu sonuçla uyumlu olarak, Herrera-Viedma ve López-Herrera (2010), Web 2.0 araçlarının kullanıcıların ilgili ve ilgisiz içeriği ayırt etmelerine yardımcı olmak için filtreleme sistemleri kullandığını ve sürekli bilgi erişimi için bireyselleştirilmiş destek sağladığını belirtmiştir. Öğretmenlerin, öğretim sürecinde yaptıkları seçimlerin doğruluğunun, alternatiflerin olumlu ve olumsuz yönlerine hâkim olmalarıyla ilişkili olduğu söylenebilir. Bu nedenle Web 2.0 araçlarının dezavantajları konusundaki görüşleri de irdelenmiştir. Katılımcıların çoğu Web 2.0 araçları kullanımına yönelik herhangi bir dezavantaj belirtmediği, daha az bir kısmının ise öğrenci ve öğretmenler açısından bazı dezavantajları olduğunu belirttiği belirlenmiştir. KÖA'lara göre öğrenciler için olası dezavantajlardan birisi, Web 2.0 araçlarının yanlış kavramalara sebep olma ihtimalidir. Kimya öğretimi mikro, makro ve sembolik düzeyler arasında ilişki kurularak gerçekleştirilir (Gabel, 1993; Johnstone, 1991) ve öğrenme sürecinde öğrenci bu üç seviye arasında geçiş yapamazsa yanlış kavramalar oluşabilir. Tanecik boyutunda sunulan görsellere odaklanan Web 2.0 araçları, ilgili geçişin gerçekleştirilmesinde risk oluşturabilmektedir. Örneğin; renkli gösterimlere yer verilen Phet Colorado, Canva veya YouTube videoları doğru biçimde hazırlanmadığında, atomların renkli olduğu yönündeki yanlış kavramalar istemeden de olsa pekişebilir (Taber ve Garcia-Franco, 2010; Talanquer, 2009). Çalışma sonucunda katılımcıların Web 2.0 araçları konusunda genel anlamda bilgi ve deneyime sahip oldukları söylenebilir. Öte yandan çalışmanın bir devlet üniversitesinde öğrenim gören KÖA'lar ile gerçekleştirilmiş olması sınırlılıklar arasında gösterilebilir. Gelecekteki araştırmalar için, KÖA'ların özellikle kimya öğretimi ve öğreniminde yapay zeka desteği sunan Web 3.0 ve yapay zekaya ek olarak artırılmış gerçeklik desteği sunan Web 4.0 hakkında bilgi ve deneyimlerinin araştırılması

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önerilmektedir. Ek olarak mevcut çalışmada olduğu gibi Web 2.0 araçlarına yönelik çalışmaların da farklı disiplinlerde ve farklı kademelerdeki katılımcılar ile gerçekleştirilerek sonuçların karşılaştırılması da önerilmektedir.

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Introduction

Due to the evolving needs of modern society, 21st-century skills are essential in today's complicated environment. These skills encompass a range of competencies that are essential for success in daily life, the workplace, schools, and other settings, such as critical thinking, higher-order thinking, technology literacy, etc. (Kocaman, 2022; Kuloğlu & Karabekmez, 2022; Miterianifa et al., 2021; Öpengin & Elmas, 2023; Sundari et al., 2023).

According to the Framework for 21st Century (P21, 2019), *"People in the 21st century live in a technology and media-driven environment, marked by various characteristics, including: 1) access to an abundance of information, 2) rapid changes in technology tools, and 3) the ability to collaborate and make individual contributions on an unprecedented scale. Effective citizens and workers of the 21st century must be able to exhibit a range of functional and critical thinking skills related to information, media, and technology".*

This quotation implies that in order to effectively incorporate technology into teaching and increase the number of students who possess these skills, teachers in the 21st century should have a high level of technological literacy. These competencies can be developed with the type of knowledge that teachers should have and is called technological pedagogical content knowledge (TPACK).

Mishra and Koehler created the TPACK framework to outline the knowledge that teachers require to successfully integrate technology into practice (Mishra and Koehler, 2006). By incorporating technology knowledge, TPACK expands upon Shulman's notion of pedagogical content knowledge (PCK) by integrating technology knowledge into this model (Harris et al., 2009; Schmidt et al., 2009). In its original version, three main components made up the TPACK framework: content, pedagogy, and technology. Four new components were subsequently added, demonstrating how the original three components interact with one another (Koehler et al., 2015) (Figure 1). In 2019, this model underwent changes and was redesigned. In its latest form, contextual knowledge has come to the forefront, encompassing a teacher's understanding of technological and physical settings, as well as the norms of their school, district, state, or country (Figure 2). Given that TPACK has a significant impact on instructors' capacity to incorporate technology into their teaching (Wu, 2013), teacher education and professional development programs must take this into account.

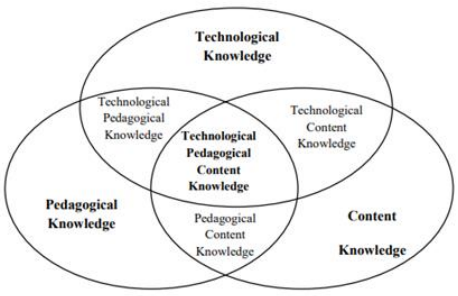

Fig. 1. The first TPACK framework (Mishra and Koehler, 2006 p. 1025)

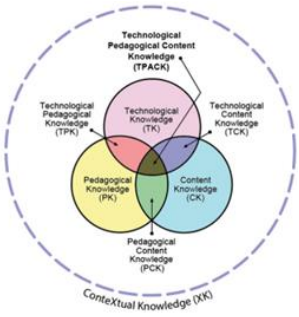

Fig. 2. Revised version of the TPACK framework (Mishra, 2019 p. 2).

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Teachers' TPACK reflects in various ways on teaching experiences, one of which is the adoption of Web 2.0 tools. The incorporation of Web 2.0 tools into educational contexts has transformed teaching and learning by enabling collaborative writing, boosting social interaction, and increasing student engagement, which are consistent with TPACK principles for successful technology integration (Malecela & Hassan, 2019).

In today's digital environment, Web 2.0 technologies are critical because they encourage people to create, share, and interact online. Their integration enhances teaching methods, increases student participation, and facilitates collaborative learning experiences in educational settings, transforming traditional classrooms into dynamic and engaging environments. Web 2.0 tools are used in the classroom to engage students in their learning, encourage peer interaction, enhance subject understanding, and create opportunities for group learning (Alhassan, 2017; Brodahl et al., 2011; Özçınar et al., 2020; Şahin-Topalcengiz & Yıldırım, 2020). They also improve experimentation and lifelong learning (Banday, 2013), increase access to educational resources, and enhance communication between educators and students (Padayachee & Moodley, 2022). Additionally, these tools promote student enthusiasm, efficacy, and competency in technology integration (Kim & Jang, 2015) and enable teachers to incorporate modern assessment techniques (Arabaci & Akilli, 2021).

There are many Web 2.0 tools that are accessible, serve specific functions, and enhance user interactions and experiences. Based on research from existing online archives, educational technology literature, internet searches, and Web 2.0 review papers, Bower proposed a typology of Web 2.0 learning technologies in 2015 and created a schematic depiction. This typology was later updated by Bower and Torrington (2020) after five years, evolving into a new framework called *Free Web-based Learning Technologies*. The goal of this updated representation is to provide a more current model.

A tool must meet the following criteria to be included in the 2020 Typology of Free Web-based Learning Technologies:

1. be freely available or at least offer a free version that may be utilized continuously (rather than only a free trial)
2. be openly accessible using an ordinary web browser
3. allow for user-generated material
4. be educationally applicable (e.g., no marketing tools offered) (p. 3).

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Fig. 3. The free web-based learning technologies (Bower and Torrington, 2020 p.2)

In determining the most effective Web 2.0 tool, it is crucial to comprehend its advantages, disadvantages, and challenges, which are outlined below:

Advantages

Enhanced interaction

Web 2.0 tools encourage reciprocal communication between students and teachers outside of scheduled class times, boosting engagement and collaboration (Abeid, 2016).

Flexibility and diversity

Students can have flexible work schedules both inside and outside the classroom and utilize Web 2.0 technologies to cater to a variety of learning styles (Yapıcı, 2022).

Increased engagement

Students find the use of Web 2.0 tools in the classroom exciting and entertaining, which leads to richer content and better learning retention (Yapıcı, 2022).

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Rich content and collaboration

Web 2.0 tools improve peer interaction, content quality, and collaboration, resulting in a deeper understanding of both social interaction and subject matter (Özçınar et al., 2020).

Promotion of lifelong learning

By integrating Web 2.0 and e-learning into current university curricula, instructors are promoting a shift in higher education toward lifelong learning, where they serve as facilitators of learning and assessors of proficiency, rather than merely dispensing materials (Ruiz et al., 2006).

Technology literacy

Utilizing a variety of Web 2.0 technologies helps students prepare for future employment and fosters technology literacy (Punie & Cabrera, 2006).

Disadvantages

Internet connection issues

Connectivity problems can interfere with online activities, making it difficult for teaching and learning to proceed smoothly (Şahin-Topalcengiz & Yıldırım, 2020).

Lack of motivation and confidence

Engagement and performance may suffer if students or teachers feel overburdened or reluctant to use these tools effectively (Şahin-Topalcengiz & Yıldırım, 2020).

Reduced face-to-face interaction

The use of Web 2.0 tools may limit face-to-face engagement between students and teachers, which is crucial for the learning process (Şahin-Topalcengiz & Yıldırım, 2020).

Software installation and update issues

Some Web 2.0 tools may require users to install and regularly update software on their devices. This can be time-consuming, especially in educational settings with multiple users and devices (Grundy et al., 2007).

Complexity and learning curve

Web 2.0 tools can be difficult to navigate at first, requiring users to devote time to learning how to use them effectively. The learning curve associated with mastering different tool interfaces can be challenging for users, particularly those who are not tech-savvy (Tetskyi et al., 2021).

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Challenges

Identifying appropriate tools

Teachers may find it difficult to choose the most effective Web 2.0 tools in educational settings that best meet their learning goals and the needs of their students (Virkus & Bamigbola, 2011).

Implementation in teaching and learning

Teachers may face challenges in effectively incorporating Web 2.0 tools into instructional practices and ensuring their smooth use by students (Virkus & Bamigbola, 2011).

Support for diverse learning styles

For teachers who want to create inclusive and effective learning environments, it is a challenge to ensure that Web 2.0 tools support diverse learning and participation styles. Otherwise, students' different learning preferences will not be addressed (Virkus & Bamigbola, 2011).

Development of necessary skills

Supporting both teachers and students in developing the skills required to use Web 2.0 tools correctly can be challenging (Virkus & Bamigbola, 2011).

Digital exclusion

When utilizing Web 2.0 tools in the classroom, it is critical to address concerns about digital exclusion. For teachers, ensuring sufficient access to technology and resolving issues with connectivity and device availability are crucial (Virkus & Bamigbola, 2011).

Intellectual property rights

Navigating intellectual property rights concerns related to content created and shared through Web 2.0 platforms can be difficult. When using these resources for instructional purposes, teachers and students must manage issues of copyright and ownership (Virkus & Bamigbola, 2011).

When the literature was examined, it was found that recent studies have focused on the use of Web 2.0 tools in the context of chemistry education. Uyulgan and Akkuzu Güven (2022) investigated the competencies of PCTs in using Web 2.0 tools, as well as their views on these tools in chemistry teaching. The results showed that the PCTs were moderately competent in using Web 2.0 tools. They also believed that most chemistry topics were difficult to comprehend due to their abstract nature and that any topic could be taught more effectively using Web 2.0 tools, such as comics or animations, to visualize the content. Ekici and Döner Aydoğan (2023) examined the effects of inquiry-based activities supported by Web 2.0 tools (Padlet and Quizizz) on students' attitudes toward chemistry in the "Acids, Bases, and Salts" unit of the 10th grade chemistry curriculum. The study found no significant difference

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between the experimental and control groups. Gencer et al. (2023) conducted research to examine Web 2.0 tools used by PCTs, the purposes for using these tools, and their justifications for preferring them in their online teaching practices in a distance education environment. The findings indicated that the most commonly used Web 2.0 tools were Perculus+ chat, Google Docs, and Quizizz. Additionally, participants used these tools for various purposes, such as capturing students' attention, gathering hypotheses, and designing experiments. The results also highlighted that participants justified their preference for nearly all of the Web 2.0 tools they used based on their ease of use, regardless of the specific purpose for which the tools were employed. Sadi Yılmaz and Yaşar (2023) investigated the effects of using Google Forms and gamification tools (Kahoot and Quizlet) in formative assessment during the online teaching of the Chemistry II course in the areas of solutions and chemical kinetics during the COVID-19 pandemic. The study revealed that using Kahoot, Quizlet, and Google Forms in online classes and during students' free time had positive effects, including more enjoyable and productive lessons, support for professional teaching skills, reinforcement of prior knowledge, and increased awareness of students' learning levels based on the feedback they received in a relaxed, competitive setting. Additionally, qualitative data indicated that these tools were particularly effective in verbal subjects. Şeker and Yalçın-Çelik (2023) examined the effects of Web 2.0 tools using a quasi-experimental design in the "Acids, Bases, and Salts" unit. In the experimental group, which used course materials developed with Web 2.0 tools, and the control group, which used traditional teaching methods, the academic achievement scores and attitudes of 10th grade chemistry students were compared. The Acids and Bases Achievement Test (ABAT) and Chemistry Course Attitude Scale (CCAS) were administered to the students as pre- and post-tests. The post-test scores (ABAT) showed a statistically significant difference in favor of the experimental group, while there was no significant difference in the chemistry attitude scores. These findings indicated that students' achievement in chemistry was enhanced by activities created using Web 2.0 tools.

The worldwide COVID-19 pandemic and the February 6th earthquakes in Türkiye forced the educational system to shift to distance education, highlighting the importance of incorporating technology, particularly Web 2.0 tools. While these tools are not entirely new, their use was less widespread prior to these global and local events. After reviewing the literature, it was found that most studies focused on PCTs' attitudes and academic performance at the end of Web 2.0-integrated teaching. However, there remains a research gap regarding what PCTs know about the nature of Web 2.0 tools. Therefore, the purpose of this study was to determine the level of knowledge and experience that PCTs have with Web 2.0 tools. The research questions are as follows:

1. What do the PCTs know about Web 2.0 tools?
2. Through which sources have the PCTs learned about Web 2.0 tools?
3. In which courses are Web 2.0 tools used at the undergraduate level for the PCTs?
4. What do the PCTs think about the advantages of Web 2.0 tools?
5. What do the PCTs think about the disadvantages of Web 2.0 tools?

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Methodology

Research design

The case study model, described as "a problem to be studied that will reveal an in-depth understanding of a 'case' or bounded system, involving an event, activity, process, or one or more individuals," serves as the framework for this research (Creswell, 2002, p. 61). From this perspective, the PCTs' understandings are utilized in the current study to examine their knowledge and experience with Web 2.0 tools.

Participants

One of the purposive sampling techniques, typical case sampling, was used to select the participants (Patton, 2005). The goal of this technique is to produce results that can be generalized to a broader context (Baltacı, 2018). Sixty-two PCTs participated in the study during the second semester of the 2023–2024 academic year. They were enrolled in the first, second, third, and fourth years of a chemistry teaching program in the western region of Türkiye. The participants took courses in field education, professional knowledge, and general cultural knowledge as part of the chemistry teaching undergraduate program. In some of these courses, teaching staff integrate technology based on their own initiative, while in others, technological tools are introduced as required by the course content. The distribution of participants by grade level is shown in Table 1.

Table 1.
The distribution of participants according to grade level

Grade levels	Frequency	TOTAL
1st grade	17	62
2nd grade	17	
3rd grade	13	
4th grade	15	

Data collection tools

An opinion form with open-ended questions, developed by the researcher and created using Microsoft Forms, was one of the two methods used to collect data. Interviews were also conducted by the researcher. The following are the questions in the opinion form:

1. Have you ever heard of Web 2.0 tools? (Research Question 1)
2. Which Web 2.0 tools are you familiar with? (Research Question 1)
3. How did you become aware of Web 2.0 tools? (Research Question 2)
4. In which courses are Web 2.0 tools used in your undergraduate degree? (Research Question 3)
5. What do you see as the possible advantages of Web 2.0 tools? (Research Question 4)
6. What do you see as the possible disadvantages of Web 2.0 tools? (Research Question 5)

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Data collection process

At the beginning of the data collection process, the researcher determined the participants' available time, sent them the data collection instrument online, and stayed with them until it was completed. The goal was to capture what the participants actually knew at that moment, without conducting additional research or engaging in discussions with one another. If any answers from the PCTs were unclear or missing, individual interviews were conducted, specifically focusing on these areas. These interviews lasted between 5 and 15 minutes.

Data analysis

The raw data were prepared prior to the descriptive and content analysis processes. An Excel file, created using Microsoft Office, contained the responses to the questions on the opinion form. Next, the interview data were transcribed verbatim, and the analysis was performed through descriptive or content analysis. The key distinction between content analysis and descriptive analysis lies in the existence or absence of predetermined themes and codes (Yıldırım & Şimşek, 2011). Descriptive analysis was used for the first and third research questions' data, while content analysis was used for the remaining data (RQ2, RQ4, and RQ5). Descriptive analysis was chosen for the first and third questions because the potential responses were predictable (Yes/No, examples of Web 2.0 tools), while the answers to the remaining questions were more difficult to predict, making content analysis more suitable. Table 2 displays the classification of the research questions and opinion form questions based on the method of analysis.

Table 2.
Classification of the research questions according to the type of analysis

Type of analysis	Research Question (RQ)	Opinion Form Question (OFQ)
Descriptive analysis	RQ1. What do the PCTs know about Web 2.0 tools?	OFQ1. Have you ever heard of Web 2.0 tools? OFQ2. Which Web 2.0 tools are you familiar with?
	RQ3. In which courses are Web 2.0 tools used at the undergraduate level for the PCTs?	OFQ4. In which courses do the Web 2.0 tools are used in your undergradate degree?
Content analysis	RQ2. Through which sources have the PCTs learned about Web 2.0 tools?	OFQ3. How did you become aware of the Web 2.0 tools?
	RQ4. What do the PCTs think about the advantages of Web 2.0 tools?	OFQ5. What do you see as the possible advantages of Web 2.0 tools?
	RQ5. What do the PCTs think about the disadvantages of Web 2.0 tools?	OFQ6. What do you see as the possible disadvantages of Web 2.0 tools?

Validity and reliability

To ensure validity and reliability both in the preparation of the data collection tools and in the analysis of the findings, the author worked closely with colleagues for support. First, the author prepared the open-ended questions after conducting a literature review, then consulted with field experts (three experts in chemistry education and one in Turkish education), and the questions were

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finalized based on their feedback. After the data analysis process, the author shared the findings with one of the experts, a professor in chemistry education. They reviewed the analysis process and results together. In case of disagreement, they revisited the data, discussed it, and even re-interviewed the PCTs. Ultimately, the Miles-Huberman (1994) inter-rater reliability coefficient was 90%. The inconsistencies were resolved, and the findings were finalized.

Ethical principles

Due to ethical principles, approval was obtained from Balıkesir University Science and Engineering Ethics Committee at the meeting dated 16.09.2024 with the number E-19928322-100-425420. Additionally, the participants' names were replaced with pseudonyms (PCT1, PCT2, PCT3, ...). The researcher initially stated that the data would be kept confidential and explained the context of the study. Participants were informed that their participation was voluntary, and they could leave the study at any time.

Findings

In this section, findings will be presented subsequently.

Findings regarding the PCTs' knowledge about the Web 2.0 tools

The findings of the first research question, regarding the PCTs' opinions on whether they have heard of Web 2.0 tools before and the examples they provided, are shown in Tables 3 and 4, categorized by grade level.

Table 3.
The distribution of PCTs' opinions on having heard of Web 2.0 tools before according to their grade level

Answer	1st grade		2nd grade		3rd grade		4th grade	
	f	%	f	%	f	%	f	%
Yes	10	16,12	4	6,45	13	20,97	15	24,20
No	7	11,29	13	20,97	0	0	0	0

It can be seen in Table 3 that more than half of the PCTs in the first, third, and fourth years have heard of Web 2.0 tools, in contrast to the second-year PCTs. Additionally, all of the third- and fourth-year PCTs are more familiar with Web 2.0 tools

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Table 4.
The distribution of examples given by the PCTs regarding Web 2.0 tools according to their grade level in the light of The 2020 Typology of Free Web-based Learning Technologies (Bower and Torrington, 2020)

Type of the Web 2.0 tools	Sub-type of the Web 2.0 tools	Example 0f the Web 2.0 tools	1st grade		2nd grade		3rd grade		4th grade	
			f	%	f	%	f	%	f	%
Assesment tools	-	Kahoot	3	4,83	3	4,83	7	11,29	13	20,97
		Quiziz	1	1,61	1	1,61	1	1,61	7	11,29
		Quizlet	-	-	2	3,22	-	-	2	3,22
		Wordwall	-	-	-	-	-	-	3	4,83
		Learningapps	-	-	-	-	-	-	3	4,83
		Socrative	-	-	2	3,22	-	-	1	1,61
		Baamboozle	-	-	-	-	-	-	1	1,61
Data analysis tools	Conducting surveys	Google Forms	-	-	-	-	-	-	8	12,90
		Mentimeter	-	-	-	-	2	3,22	1	1,61
Text based tools	Note-taking and document creation	Canva	1	1,61	-	-	3	4,83	10	16,12
		Thinglink	-	-	-	-	-	-	1	1,61
Video tools	Video sharing	Youtube	4	6,45	-	-	3	4,83	-	-
Multimodal production tools	Digital pinboards	Padlet	-	-	3	4,83	2	3,22	2	3,22
	Presentations	Prezi	-	-	-		-	-	4	6,45
		Powerpoint	-	-	-		2	3,22	1	1,61
Digital storytelling tools	Animated videos	Phet Colorado	1	1,61	-	-	3	4,83	10	16,10
		Powtoon	-	-	-		-	-	1	1,61
		Voki	-	-	1	1,61	-	-	-	-
	Online book creation	Storybird	-	-	-	-	-	-	4	6,45
		Storyjumper	-	-	-	-	-	-	1	1,61
Image based tools	Word clouds	Word Cloud	4	6,45	-	-	3	4,83	-	-
		Wordart	5	8,06	-	-	1	1,61	-	-
	Mindmapping	Mindmeister	-	-	3	4,83	2	3,22	2	3,22
Website creation tools	Wikis	Wikipedia	5	8,06	-	-	1	1,61	1	1,61

As seen in Table 4, the most frequently mentioned example of Web 2.0 tools (Kahoot) fall under the category of assessment tools. Additionally, the PCTs provided different examples for various categories, such as data analysis tools, text-based tools, video tools, multimodal production tools, digital storytelling tools, image-based tools, and website creation tools. The quotations from the PCTs regarding this research question are as follows:

PCT47 (Assessment tools/Kahoot-1st grade): … I know Kahoot…

PCT18 (Assessment tools/Kahoot, Data analysis tools/Conducting surveys-Google forms, Text based tools/Note taking and document creation-Canva, Digital storytelling tools/Animated videos-Phet Colorado-4th grade): … In a TÜBİTAK project, we got information about Kahoot, Google Forms, Canva, and Phet. These examples came to my mind at first...

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Findings regarding the sources from which PCTs obtained knowledge about Web 2.0 tools

The findings of the second research question, related to the sources from which the PCTs obtained knowledge about Web 2.0 tools according to their grade level, are shown in Table 5.

Table 5.
The distribution of sources from which participants obtained knowledge about Web 2.0 tools according to their grade level

Sources	1st grade		2nd grade		3rd grade		4th grade	
	f	%	f	%	f	%	f	%
Undergraduate degree courses	5	8,06	3	4,83	9	14,51	13	20,97
Workshops/projects	-	-	-	-	-	-	4	6,45
Individual research	3	4,83	-	-	-	-	-	-
Social media	1	1,61	-		-	-	-	-
Games	-	-	-		1	1,61	-	-

Upon examining Table 5, it can be seen that undergraduate degree courses are the primary source of knowledge for PCTs regarding Web 2.0 tools. The second most common source is workshops in which they participated. Additionally, the PCTs cited individual research, social media, and games as other sources of knowledge about Web 2.0 tools. The quotations from the PCTs regarding this research question are as follows:

PCT20 (Undergraduate degree courses-4th grade): …We learnt during the courses here …

PCT25 (Workshops/projects-4th grade): … I participated in a TÜBİTAK project last summer which was about these tools…

PCT39 (Social media-1st grade): … I saw Kahoot on social media, "Who wants to be a millionaire" is just a Kahoot do you know?

Findings regarding the courses inwhich the Web 2.0 tools were used according to the PCTs

The findings of the third research question, related to the courses in which Web 2.0 tools were used according to the PCTs, are shown in Table 6.

Table 6.
The distribution of the courses in which the PCTs stated that the Web 2.0 tools were used by grade level

Course Types	Courses	1st grade		2nd grade		3rd grade		4th grade	
		f	%	f	%	f	%	f	%
Field education courses	Material design in chemistry	-	-	-	-	1	1,61	4	6,45
	Physical chemistry	-	-	-	-	1	1,61	4	6,45
	Chemistry teaching	-	-	-	-	-	-	2	3,22
	Development of alternative measurement techniques	-		1	1,61	-	-	1	1,61
	General mathematics	1	1,61	-	-	1	1,61	-	-
	Chemistry in everyday life	-		-		-	-	1	1,61
	General chemistry	-		1	1,61	-	-	-	-

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	General physics	1	1,61	-	-	-	-	-	-
	Laboratory safety	1	1,61	-	-	-	-	-	-
Professional knowledge courses	Micro teaching	-	-	-	-	-	-	2	3,22
General cultural courses	Internet practices in science	-	-	-	-	-	-	1	1,61
	Information technologies	1	1,61	-	-	-		-	-

Table 6 shows that field education courses are the most frequently mentioned, followed by professional knowledge and general cultural courses in terms of Web 2.0 tool usage. Among the field education courses, material design in chemistry and physical chemistry courses are the most prominent. The quotations from the PCTs regarding this research question are as follows:

PCT59 (Field Education Courses/Physical Chemistry-3rd grade): …Physicochemistry is a very challenging course, but the instructor used Web 2.0 tools in this course.

PCT24 (Professional Knowledge Courses/ Micro Teaching-4th grade): … I learnt how to prepare and use Web 2.0 tools in material design course.

PCT27 (General Cultural Courses/Internet Practices in Science-4th grade): … I heard the Web 2.0 tools in the internet practices in science course, an elective course.

Findings regarding to the considerations of PCTs' about the advantages of Web 2.0 tools

The findings of the fourth research question, related to the PCTs' considerations about the advantages of Web 2.0 tools, are shown in Table 7.

Table 7.
The distribution of the PCTs' considerations on the advantages of Web 2.0 tools according to their grade level

Target Group	**Advantages**	**1st grade**		**2nd grade**		**3rd grade**		**4th grade**	
		f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Students	Enables learning	7	11,29	3	4,83	4	6,45	6	9,67
	Provides faster access to information	6	9,67	1	1,61	-	-	-	-
Teachers	Facilitates teaching due to practicality	1	1,61	-	-	-	-	3	4,83
	Provides measurement	-		-		1	-	1	1,61
Students and teachers	Provides modernization	1	1,61	2	3,22	-	-	2	3,22
	Provides intertwining with technology	1	1,61	2	3,22	1	1,61	-	-
	Contributes to visuality	1	1,61	1	1,61	1	1,61	1	1,61
	Provides more economical teaching	-	-	-	-	1	1,61	2	3,22
	Increases teacher-student interaction	-	-	-	-	-	-	1	1,61

Table 7 shows that the PCTs are knowledgeable about the advantages of Web 2.0 tools in terms of students, teachers, and both. Furthermore, it was found that they believe there are various advantages for each group. The quotations from the PCTs regarding this research question are as follows:

PCT46 (Students/Enables learning/1st grade): … I think the best contribution is enabling learning. They (Web 2.0 tools) are colorful, interactive, exciting, and dynamic. So, we can have fun when using it, them…

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PCT26 (Students/Facilitates teaching due to practicality/4th grade): … Web 2.0 tools ease the teacher's burden. For instance, assessment can be done easily with Kahoot. The teacher prepares the questions online, eliminating the need to print them, read them, and manually mark the answers, as is done in traditional teaching. All process carries on at that moment, at the end students can see the correct/wrong answers, their score in the class. It is so practical then.

PCT5 (Students and teachers/Provides intertwining with technology/2nd grade): … Both students and teachers are faced with the challenge of being intertwined with technology, regardless of whether they are technologically literate or not…

Findings regarding to the considerations of PCTs' about the disadvantages of Web 2.0 tools

The findings of the fifth research question, related to the PCTs' considerations about the disadvantages of Web 2.0 tools, are shown in Table 8.

Table 8.
The distribution of the PCTs' considerations on the disadvantages of the Web 2.0 tools according to their grade level

Target Group	Disadvantage	1st grade		2nd grade		3rd grade		4th grade	
		f	%	f	%	f	%	f	%
No one	I don't think there is a disadvantage	6	9,67	6	9,67	4	6,45	3	4,83
	I don't know	4	6,45	7	11,29	1	1,61	1	1,61
Teachers	Technological equipment may be insufficient	-	-	1	1,61	4	6,45	6	9,67
	Time may be limited	-	-	-	-	3	4,83	3	4,83
Students	Students can get used to the ready-made	5	8,06	1	1,61	1	1,61	1	1,61
	Students' readiness may be insufficient	-	-	1		-	-	-	-
	Student control may be challenging	-	-	-	-	-	-	1	1,61
	May cause misconceptions	1	1,61	-	-	-	-	-	-

Table 8 shows that most of the PCTs have no knowledge of the disadvantages of Web 2.0 tools. Furthermore, it was found that fewer of them provided specific examples of disadvantages for teachers and students. The quotations from the PCTs regarding this research question are as follows:

PCT21 (No one/I don't think there is a disadvantage/4th grade): …How can it has any disadvantage? If it has then why is it so popular?...

PCT9 (No one/I don't think there is a disadvantage/2nd grade): …Such a funny thing has a negative side?...

PCT30 (Teachers/Technological equipment may be insufficient/4th grade): …We see that in real classrooms, the internet connection is weak, students do not have mobile phones. Then what can a teacher do in these insufficient contexts?

PCT48 (Teachers/Time may be limited/3rd grade): …Preparing a Web 2.0 tool is a time-consuming activity and utilizing it can prolong. So, I think that Web 2.0 tools can challenge a teacher in terms of time...

PCT22 (Students/Students can get used to the ready-made/4th grade): … Students can laze, can enjoy ready-made exams, quizzes even the experiment equipment. Because everything comes ready in front of the student.

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Discussion, Conclusion and Suggestions

The purpose of this study was to uncover the PCTs' current knowledge and experiences with Web 2.0 tools. The research was organized, and data were gathered through open-ended questions and interviews.

The initial focus was on the PCTs' current knowledge, specifically their understanding of Web 2.0 tools and the examples they were familiar with. The results indicated that the PCTs in the first, third, and fourth years have heard of Web 2.0 tools, in contrast to the second-year PCTs. Additionally, all of the third- and fourth-year PCTs are more familiar with Web 2.0 tools. This result might be attributed to the course materials, the preferences of the course instructors, or the PCTs' experiences from other sources. On the other hand, in the last two years of the program, there are more teaching-oriented courses, such as chemistry teaching and micro-teaching, which may have enhanced the PCTs' understanding of Web 2.0 tools.

The PCTs' responses to Web 2.0 tools were initially linked to assessment purpose, which is one of the more challenging components of teaching. The most common response from the PCTs when asked which Web 2.0 tools they had heard of was Kahoot, which enables teachers to build quizzes based on course material. This popularity may be related to its features, such as its game-show-like nature (Wang, 2015). By using Kahoot, teachers can incorporate gamification elements like audio and a scoreboard with a points system into informal assessments (Licorish et al., 2015). Teachers should seek various formative or summative assessment methods that include unique, humorous, accessible, and interactive features via Web 2.0 tools, especially given students' disinterest in traditional paper and pencil assessment methods. Therefore, teachers should be knowledgeable about these tools because students' needs may shape teachers' assessment choices. Kahoot offers several advantages that can enhance student learning through its dynamic and engaging features. It fosters social interaction among students (Antoniou et al., 2016; Sweetser & Wyeth, 2005; Wang, 2017), reduces student anxiety by using nicknames (Lee et al., 2019; Turan & Meral, 2018), and presents a challenge with uncertain outcomes that promotes enjoyment, motivation, and focus (Chaiyo & Nokham, 2017; Wang, 2015). It also uses music, sound, and animated images to maintain student interest (Baydaş & Çiçek, 2019; Biçen & Kocakoyun, 2018; Bryant et al., 2018). Along with Kahoot, the PCTs also mentioned PhET Colorado, a Web 2.0 platform that provides simulations tailored to chemistry, physics, and biology. PhET simulations are valuable tools for chemistry teaching due to their internet-free access (Zulkifli et al., 2022), enhancement of conceptual understanding (Azzubairiyah et al., 2022), replacement of traditional laboratory experiences (Wirda et al., 2023), provision of opportunities when physical lab access is limited (Sari et al., 2021), and improvement of students' attitudes toward chemistry learning (Salame & Makki, 2021). In light of these advantages, it can be said that if the PCTs incorporate PhET into their future teaching, they can contribute to students' learning experiences.

It became apparent that undergraduate courses and workshops/projects also contributed to the PCTs' knowledge of Web 2.0 tools. Providing preservice teachers with technologically rich experiences in teacher education programs can help them integrate these technologies into their future classroom settings. According to Tünkler (2021), such experiences can form the foundation of their future professional practice. Additionally, Web 2.0 tools in higher education are effective at

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bringing individuals and materials together, promoting interaction, encouraging teamwork and active engagement, and fostering critical thinking. However, for Web 2.0 tools and processes to become embedded in mainstream teacher preparation programs, they must be perceived as adding significant value to instructional processes (Peterson-Ahmed et al., 2018).

The question of which courses contributed to the PCTs' knowledge of Web 2.0 tools also emerged. According to the PCTs, field education courses made greater use of Web 2.0 tools than general cultural and professional knowledge courses. Instructors in field education classes can use these resources not only to teach content but also to explain what Web 2.0 tools are, how to use them, and when they are most effective for teaching chemistry. However, in the remaining courses (general pedagogical and general cultural courses), instructors may provide more general information about Web 2.0 tools. This can be seen as beneficial as it allows PCTs to integrate what they have learned in these courses with each other. As previously mentioned, the more a preservice teacher learns about new technologies, the more intentionally, regularly, and voluntarily she can use them in her future professional life.

To the extent that a teacher is knowledgeable about Web 2.0 tools, she can make more conscious choices regarding their pros and cons. The use of Web 2.0 tools offers many advantages for both students and teachers (Elmas & Geban, 2012). The findings revealed that the PCTs are knowledgeable about the advantages of Web 2.0 tools in terms of their impact on students, teachers, and both. The most frequently expressed advantage was the contribution of Web 2.0 tools to learning, which aligns with the literature (Balcı Çömez et al., 2022; Faizi et al., 2015). Another advantage for students, according to the PCTs, is faster access to information. In line with this result, Herrera-Viedma and López-Herrera (2010) noted that Web 2.0 tools use filtering and recommender systems to help users discern between relevant and irrelevant content, offering individualized support for continuous information access. Additionally, users can obtain up-to-date information without having to visit the website. This reduces information overload while also making websites easier to navigate (Harinarayana & Raju, 2010). The practicality of Web 2.0 tools helps both teachers and students by making them easy to use and access. A teacher should not be challenged by the tool itself when aiming to perform effective teaching. The simpler a tool is, the more smoothly it can be integrated into teaching. Web 2.0 tools have the potential to bring about modernization for both teachers and students, and in turn, both groups can enhance their digital literacy. In an ideal classroom, the teacher and students should be able to communicate with one another with ease. According to the participants, Web 2.0 tools make this possible. In terms of cost and time, Web 2.0 tools are also advantageous for both teachers and students. One of the key factors for the effective use of Web 2.0 tools is their free and open accessibility (Ergun, 2019). In other words, anyone using these technologies is freed from constraints related to schedule, location, or payment. Furthermore, as long as the internet connection is uninterrupted, anyone can access information at any time and from any place. The limitations imposed by class schedules—both during the week and on weekends—vanish as a result. Yılmaz et al. (2021) claimed that Web-based education has several advantages, including the ability to learn at one's chosen time and place, access course materials based on motivation and learning speed, quickly and easily obtain information, and benefit from a rich learning environment with text, graphics, and video resources. The ability of teachers to make effective educational choices also depends on their understanding of the negative aspects of any issue. While the majority of

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participants felt that Web 2.0 tools had no significant disadvantages, a smaller portion pointed out some drawbacks for both teachers and students. One of the main obstacles for students is the possibility of creating misconceptions, particularly in the context of chemistry. In chemistry, three levels—micro, macro, and symbolic—are crucial (Gabel, 1993; Johnstone, 1991). Any inability to shift between these levels can lead to misconceptions. In the current research, Web 2.0 tools that emphasize particle-scale representations could potentially contribute to misconceptions. For example, videos on YouTube, Canva, and PhET often use colored representations that could lead to widespread misconceptions, such as the idea that atoms have color (Talanquer, 2009; Taber & Garcia-Franco, 2010). Time constraints and technological limitations may also present disadvantages for teachers. Regardless of how competent the teacher is, if the necessary tools (e.g., computer, mobile phone, internet connection, projector) are insufficient, the teaching process can be hindered.

Finally, the current research showed that the PCTs gained knowledge and experience about Web 2.0 tools from various sources, including their undergraduate chemistry teaching program. As mentioned earlier, preservice teachers need to be competent in this area as future educators. This competency will allow them to determine which tools are most effective in different circumstances and to critically evaluate and compare the tools. The course content should encourage them to develop these skills. On the other hand, the fact that the study was conducted with PCTs studying at a state university can be considered a limitation

For future research, it is well known that Web 2.0 tools are not the final step in technological advancement. As technology continues to develop, it is recommended to investigate their knowledge and experience regarding Web 3.0 technologies, which provide artificial intelligence support, and Web 4.0 technologies, which provide augmented reality support in addition to artificial intelligence. Additionally, as in the current study, it is suggested that studies on Web 2.0 tools be conducted with participants from different disciplines and levels, and that the results be compared.

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