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Argümantasyona Dayalı Öğretimin Fen Bilgisi Öğretmen Adaylarının Asit Yağmurları Konusundaki Anlayışlarına Etkisi

The Effect of Argumentation-Based Instruction on Pre-service Science Teachers' Understanding of Acid Rain

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Özet: Bu araştırmada argümantasyona dayalı öğretim yönteminin fen bilgisi öğretmen adaylarının asit yağmurları konusundaki anlayışlarına etkisinin belirlenmesi amaçlanmıştır. Araştırmada tek gruplu ön test son test desen kullanılmıştır. Araştırmanın örneklemini, Türkiye'nin batısında yer alan bir üniversitenin eğitim fakültesi Fen Bilgisi Öğretmenliği programında öğrenim gören 14 ikinci sınıf öğretmen adayı oluşturmuştur. Argümantasyona dayalı dersler "Kimyasal Atıklar ve Çevre Kirliliği" dersi kapsamında gerçekleştirilmiştir. Öğretim etkinlikleri araştırmacılar tarafından hazırlanmış olup öğretim 3 ders saatinde gerçekleştirilmiştir. Fen bilgisi öğretmen adaylarının asit yağmurlarıyla ilgili bilgilerini ölçmek ve öğretimin etkisini belirlemek için ilgili alanyazın araştırılarak (Asit yağmurları nasıl oluşur, Asit yağmurlarına sebep olan gazlar nelerdir, Asit yağmurlarının çevreye etkisi nasıldır, Asit yağmurlarının canlılar üzerine etkisi nasıldır, Asit yağmurlarını önlemek için neler yapılabilir) şeklinde beş tane açık uçlu soru hazırlanmıştır. Bu sorular fen bilgisi öğretmen adaylarına öğretim öncesi ve sonrasında uygulanmıştır. Araştırmadan elde edilen veriler betimsel analiz yöntemiyle incelenerek bulgular elde edilmiştir. Analizde kullanılan temalar, açık uçlu sorulara paralel olacak şekilde yapılandırılmış ve ortaya çıkan temalar öğretim öncesi ve öğretim sonrası karşılaştırılarak sunulmuştur. Araştırma sonucunda öğrencilerin asit yağmurlarının sebeplerine ve etkilerine yönelik kavramsal anlama düzeylerinde artış olduğu belirlenmiştir. Çalışma sonucunda, argümantasyona dayalı öğretim yönteminin öğrencilerin asit yağmurlarıyla ilgili kavramsal anlama düzeylerini olumlu biçimde etkilediği sonucuna ulaşılmıştır. Argümantasyon yöntemi fen bilgisi öğretmen adaylarının çevresel bir problem olan asit yağmurlarına çözüm geliştirmelerini sağlayıcı zengin bir tartışma ortamı sağlamıştır.

Anahtar Kelimeler: Asit yağmurları, argümantasyon, fen bilimleri

Abstract: This study aimed to determine the effect of argumentation-based teaching methods on pre-service science teachers' understanding of acid rain. A one-group pre-test and post-test design was used in the study. The sample of the study consisted of 14 2nd year pre-service science teachers studying in the science teaching department of the faculty of education of a university located in the west of Turkey. Argumentation-based lessons were carried out within the scope of the 'Chemical Wastes and Environmental Pollution' course. The researchers prepared the teaching activities was which were carried out in 3 lesson hours. In order to measure the knowledge of pre-service science teachers about acid rain and to determine the effect of teaching, five open-ended questions were prepared by searching the relevant literature (How acid rain occurs, What are the gases that cause acid rain, What is the effect of acid rain on the environment, What is the effect of acid rain on living things, What can be done to prevent acid rain). These questions were applied to pre-service science teachers before and after teaching. The data obtained from the research were analysed by descriptive analysis method, and findings were obtained. The themes used in the analysis were structured in parallel with the open-ended questions and the emerging themes were presented by comparing before and after the instruction. As a result of the study, it was determined that there was an increase in students' conceptual understanding of the causes and effects of acid rain. As a result of the study, it was concluded that the argumentation-based teaching method positively affected students' conceptual understanding levels of acid rain. The argumentation method provided a rich discussion environment for pre-service science teachers to develop solutions to acid rain, which is an environmental problem.

Key Words: Acid rain, argumentation, science

Introduction

Argumentation is a social process in which a student defends a scientific idea they believe in and attempts to refute opposing views using scientific data, and in which two or more people critique and structure arguments (Nussbaum, 2002; cited in Er & Kırındı, 2020). Toulmin (1958) defined argumentation as the process by which individuals structure their thoughts, justify them, and present evidence that supports or refutes these thoughts. In this process, claims are supported through justifications and evidence, and critical thinking and scientific debate skills are developed. According to Toulmin's Argument Model, a sound argumentation has three main components: claim (the thought being defended), justification (the fundamental reasons supporting this thought), and evidence (scientific data or observations confirming the justification). These components structure the argumentation process, supporting students in organising their ideas and reasoning. The argumentation-based teaching method is an approach that is gaining increasing importance in science education. It not only shows students that science is a social process but also enables them to achieve a deeper understanding of scientific concepts. Within the framework of science education, argumentation encourages students to view scientific information critically, while also allowing them to develop thought systems based on scientific evidence. Driver et al. (2000), emphasizing that argumentation is a social process, state that through the argumentation method, students will learn to think and debate like scientists, to distinguish non-scientific information, to interpret scientific information from different perspectives, and to construct arguments like scientists based on evidence. In this context, argumentation goes beyond teaching students ways to achieve scientific thinking; it encourages them to view science as an area of inquiry and debate.

Research on Students' Understanding of Acid Rain

The topic of acid rain is addressed in the current Science curriculum in Turkey, particularly in the "Matter and Industry" unit at the 8th grade level (Ministry of National Education, 2024). In this context, the aim is for students to understand that gases such as sulphur dioxide (SO_2) and nitrogen dioxide (NO_2), which are released into the atmosphere as a result of the combustion of fossil fuels, react with water vapour to form acid rain. Furthermore, the negative effects of acid rain on soil, water resources, vegetation, and historical structures are discussed, aiming to develop individual and societal responsibility awareness towards environmental issues. The topic is linked to disciplines such as chemistry (acid-base reactions), geography (industrial areas and wind directions) and environmental education (sustainable living), offering a multifaceted learning environment. During the teaching process, experiments, visual materials and discussion activities encourage active student participation, while values such as responsibility, sensitivity and cooperation are taught to reinforce environmental awareness.

There are numerous studies in the literature on acid rain involving different participant groups (secondary school students, high school students, teachers and pre-service teachers) (Ayvacı & Çoruhlu, 2009; Babuçcu, 2016; Boyes & Stanisstreet, 1998; Bulduk & Aydoğdu, 2022; Kıryak & Özdilek, 2019; Özcan & Demirel, 2019; Summers et al., 2001; Kahraman, 2020; Karakaya Cirit & Aydemir, 2021; Khalid, 2003; Wan et al., 2023). Research has revealed widespread misconceptions and knowledge gaps regarding the formation, sources, and effects of acid rain, particularly at the secondary school level (Ayvacı & Çoruhlu, 2009; Boyes & Stanisstreet, 1998; Karakaya Cirit & Aydemir, 2021). In this context, systematic conceptual errors have been found in interconnected topics such as global warming, the greenhouse effect, and acid rain (Özcan & Demirel, 2019), and students' knowledge levels have been found to be low.

These difficulties in the learning process once again highlight the critical importance of subject knowledge and conceptual understanding for teachers and teacher candidates. Indeed, a study conducted with pre-service science teachers found that deficiencies in fundamental chemistry topics such as acids, bases, and neutralisation also negatively affected their understanding of environmental issues such as acid rain (Babuçcu, 2016). Similarly, it has been determined that pre-service science teachers have

misconceptions about the greenhouse effect (Kahraman, 2020), while chemistry teachers' explanations of the damage caused by acid rain, the ozone layer, and the greenhouse effect are inadequate (Wan et al., 2023). Furthermore, it has been revealed that participants struggle to limit the source of acid rain solely to human activities and to relate its formation mechanism to nitrogen and sulphur emissions (Babuçcu, 2016; Khalid, 2003). The effectiveness of various teaching methods has been investigated to address these problems experienced by participants. Research has shown that constructivist teaching methods such as TAGA (Kıryak & Özdilek, 2019) and the model-based inquiry approach in socio-scientific subject teaching can increase students' environmental awareness and conceptual understanding when applied with enriched activities (Bulduk & Aydoğdu, 2022). Teachers wishing to implement model-based activities in their classrooms are advised to prepare activities that encompass a variety of models in their model design work (Bulduk & Aydoğdu, 2022).

Recently, efforts have also been made to develop alternative materials. Balkız Kalkan and Çelikler (2024) developed scientific cartoons addressing environmental issues, including acid rain, within the framework of the "Human and Environmental Relations" theme for fifth-grade students. Çelikler and Aksan (2025) have also designed informative posters enriched with scientific cartoons to develop sustainable environmental literacy among secondary school students. Such visual and creative materials attract students' attention, concretise abstract environmental concepts, and ensure lasting learning.

All these findings clearly show that conceptual understanding and knowledge of acid rain must be developed at every level, from students to teacher candidates. Accordingly, Kahraman (2020) emphasised that, in order to increase pre-service science teachers' competence in this area, science education degree programmes should include more courses focused on environmental education and enriched with contemporary pedagogies.

Studies on the Effect of Argumentation Methods on Student Learning

The role and effectiveness of argumentation in science education is supported by research covering all levels of education from primary school to university. Studies have demonstrated the positive effects of this method on conceptual understanding, critical thinking, motivation, scientific literacy, and argumentation skills. One of the most prominent effects of argumentation is that it increases students' levels of conceptual understanding and reduces conceptual misconceptions. This has been demonstrated by Aygün et al. (2016) at primary school level on the topic of 'melting and dissolution' and by Kıryak and Özdilek (2019) at secondary school level on environmental topics such as 'acid rain'. At the secondary school level, Demirci-Celep (2015) on gases, Venville and Dawson (2010), and Zohar and Nemet (2002) on genetics found that the quality of students' arguments improved and their conceptual understanding strengthened in abstract and difficult subjects. Osborne and colleagues (2004) state that a similar environment ensures that science concepts are correctly linked within themselves. The argumentation process not only teaches students what they know but also teaches them how to use this knowledge. Kalemkuş and colleagues (2021) found in their study that argumentation significantly contributes to primary school pupils' critical thinking, prediction-observation-explanation and reasoning skills, while Er and Kırındı (2020) found that it significantly contributes to secondary school pupils' scientific process skills and academic achievement. Researchers conducting studies at secondary school and university levels emphasised that argumentation develops students' abilities to construct scientific evidence, share ideas, write scientifically (Antonio & Prudente, 2021), and make logical explanations (Eymur, 2019). Rivera et al. (2021) argued that argumentation increases student participation through critical thinking and should be used more frequently in science education. According to Çiğdemoğlu et al. (2017), the argumentation method contributes to scientific literacy. Through argumentation, students increase their interest in the subject and their participation in lessons. For example, it has been observed that secondary school students' interest in chemistry lessons has increased (Özelma & Güngör Seyhan, 2023) and that they can produce components such as claims, data, and justifications without getting bored in lessons supported by technological applications (Yıldırım & Sağlam, 2025). Furthermore, it has been emphasised that students' argumentation levels increase over time (Türk & Yıldırım, 2025) and that these skills can be significantly developed at secondary school level through problem-solving-

focused lessons (Marthaliakirana, et al., 2022). All these findings demonstrate that the argumentation method is an effective teaching tool for science lessons. Researchers suggest that, in order to use this method more effectively, teachers should organise their lessons in a problem-solving-oriented manner (Marthaliakirana, et al., 2022) and organise their lessons by carefully combining technology tools, the argumentation process and content knowledge (Yıldırım Sağlam, 2025).

These studies, which employ argumentation methods, demonstrate that argumentation helps students better understand abstract and complex concepts, develops their critical thinking skills, and provides opportunities for students to recognise their existing misconceptions and correct these errors. Studies on environmental issues such as acid rain have revealed that students have insufficient knowledge about these issues. In lessons based on the argumentation method, it is possible for students to gain environmental awareness by understanding scientific issues affecting the environment, such as acid rain, and generating solutions through scientific and socio-scientifi&c discussions. Jiménez-Aleixandre and Erduran (2008) state that argumentation not only develops scientific thinking but also increases students' sense of social responsibility and awareness of environmental issues. This is of great importance in teaching environmental topics such as acid rain. With this method, students will not only learn how acid rain is formed but also become aware of their misconceptions. For these reasons, investigating the effect of the argumentation method on learning about acid rain will not only increase students' scientific understanding but also contribute to their development of environmental awareness, critical thinking, and social responsibility. This study aims to determine how argumentation-based teaching methods affect pre-service science teachers' understanding of acid rain and to identify their levels of argumentation on the subject. To this end, the following questions were addressed:

1. How does argument-based teaching affect pre-service science teachers understand of acid rain?
2. What are the argument levels of pre-service science teachers regarding acid rain, a socio-scientific issue?

Method

In this study, weak experimental methods were employed from among experimental methods, and within this framework, a single-group pre-test-post-test design was utilised. The most important feature of experimental methods is that they provide an opportunity to measure the cause-and-effect relationship between the variables to be observed (Köklü & Büyüköztürk, 2000). Based on the data obtained from a single experimental group, the difference between the pre-test and post-test scores is examined, and if a significant difference is found, it is accepted that this difference is due to the intervention (Baştürk, 2009).

Sample

The study involved 14 second-year science teacher candidates studying at an education faculty located in western Turkey. In the sample selection, convenient sampling was used from among non-random sampling methods. Büyüköztürk et al. (2015) define convenient sampling as selecting a sample that is suitable for the circumstances due to existing limitations such as time, money, and location. The names of the teacher candidates were not used to keep their identities confidential. The students were coded as PS1, PS2, PS3…. and PS14, and the groups were coded as G1 to G7.

Data Collection Process

The study process began with the pre-testing of the data collection instrument. Subsequently, the first author conducted argumentation-based teaching consisting of three lessons, each lasting 45 minutes. The argumentation-based teaching activities were prepared by the researchers. These lessons were conducted within the scope of the "Chemical Waste and Environmental Pollution" course. After the argumentation-based activities, the data collection tool applied at the beginning of the teaching was reapplied as a final test. The data collection and teaching process is shown in Figure 1.

In the argumentation activities, each student was given worksheets and asked to complete the activities individually first. Then, the students were asked to discuss in groups of 4-5, share their ideas

and compare them. As a result of the discussions, the groups presented their arguments to the class through their chosen spokespersons. During the presentations, the teacher acted as a guide, encouraging students to formulate counterarguments in a questioning manner. At the end of the lesson, a general class discussion was held to evaluate the arguments presented and determine what constitutes a correct and strong argument.

In the first lesson, an activity aimed at introducing arguments to the students was carried out. In this activity, arguments and their components were explained through a dialogue between two students (Yıldırır, 2013). To enable students to experience the discussion and argument example first-hand, they were asked to discuss a current issue they were familiar with. The components of an argument were revisited using examples from the students' discussion. Students were presented with an argument example related to a science topic and asked to write an argument on any topic of their choice. Finally, the arguments written by the students were evaluated, and the characteristics of a good argument were emphasised. A concept cartoon was used in the second lesson. The concept cartoon presented two different claims about the effect of acid rain on lakes. Students were first asked to decide which claim was correct and then to support their claims with data and reasoning (Figure 2a). A sociological activity was prepared for the third lesson. In this lesson, students were given the worksheet shown in Figure 2b. Students were first asked to read the text on the worksheet. They were then asked to form pairs, discuss the topic, and present their arguments in a report. During their presentations, the groups discussed, defended their claims, tried to justify themselves, and attempted to persuade each other.

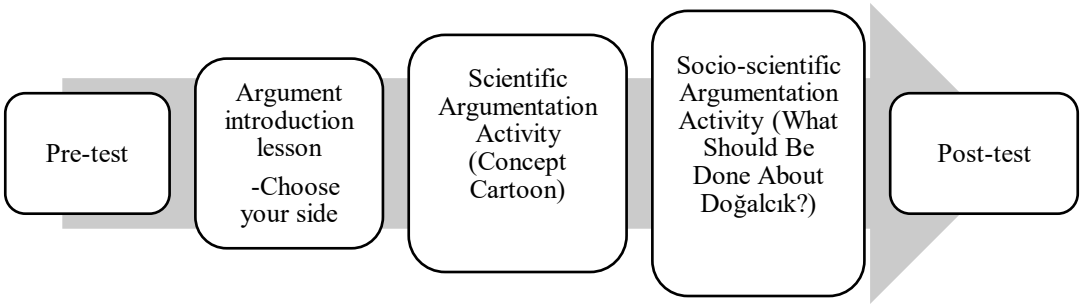
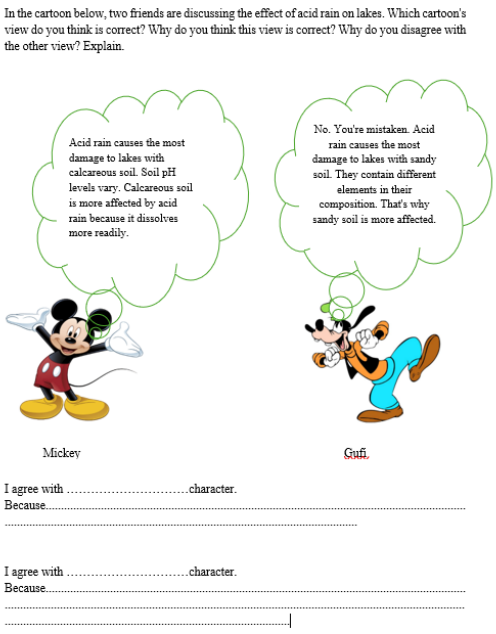


Figure 1. *Data Collection Process*


In the cartoon below, two friends are discussing the effect of acid rain on lakes. Which cartoon's view do you think is correct? Why do you think this view is correct? Why do you disagree with the other view? Explain.

Acid rain causes the most damage to lakes with calcareous soil. Soil pH levels vary. Calcareous soil is more affected by acid rain because it dissolves more readily.

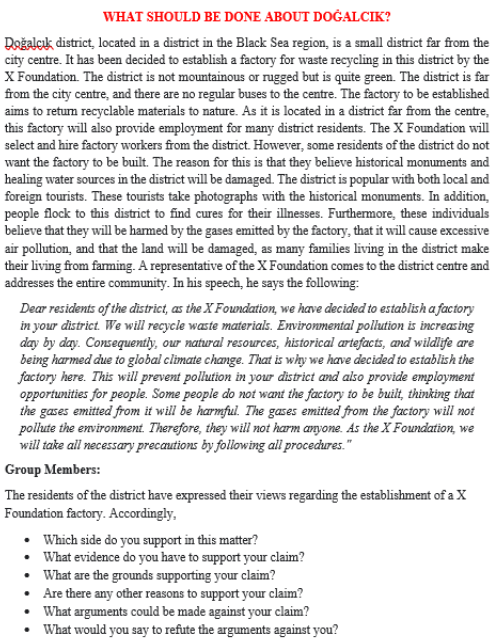
No. You're mistaken. Acid rain causes the most damage to lakes with sandy soil. They contain different elements in their composition. That's why sandy soil is more affected.

Mickey

Gufi

I agree with ……character.
Because.....
.....

I agree with ……character.
Because.....
.....
.....


WHAT SHOULD BE DONE ABOUT DOĞALCIK?

Doğalcık district, located in a district in the Black Sea region, is a small district far from the city centre. It has been decided to establish a factory for waste recycling in this district by the X Foundation. The district is not mountainous or rugged but is quite green. The district is far from the city centre, and there are no regular buses to the centre. The factory to be established aims to return recyclable materials to nature. As it is located in a district far from the centre, this factory will also provide employment for many district residents. The X Foundation will select and hire factory workers from the district. However, some residents of the district do not want the factory to be built. The reason for this is that they believe historical monuments and healing water sources in the district will be damaged. The district is popular with both local and foreign tourists. These tourists take photographs with the historical monuments. In addition, people flock to this district to find cures for their illnesses. Furthermore, these individuals believe that they will be harmed by the gases emitted by the factory, that it will cause excessive air pollution, and that the land will be damaged, as many families living in the district make their living from farming. A representative of the X Foundation comes to the district centre and addresses the entire community. In his speech, he says the following:

Dear residents of the district, as the X Foundation, we have decided to establish a factory in your district. We will recycle waste materials. Environmental pollution is increasing day by day. Consequently, our natural resources, historical artefacts, and wildlife are being harmed due to global climate change. That is why we have decided to establish the factory here. This will prevent pollution in your district and also provide employment opportunities for people. Some people do not want the factory to be built, thinking that the gases emitted from it will be harmful. The gases emitted from the factory will not pollute the environment. Therefore, they will not harm anyone. As the X Foundation, we will take all necessary precautions by following all procedures."

Group Members:

The residents of the district have expressed their views regarding the establishment of a X Foundation factory. Accordingly,

- Which side do you support in this matter?
- What evidence do you have to support your claim?
- What are the grounds supporting your claim?
- Are there any other reasons to support your claim?
- What arguments could be made against your claim?
- What would you say to refute the arguments against you?

a) Scientific argumentation activity (Concept cartoon)

b) Socio-scientific argumentation activity

Figure 2. *Worksheets used in lessons*

Data Collection Tool

An open-ended questionnaire was used as a data collection tool to determine pre-service science teachers' understanding of acid rain and to learn about changes in their understanding as a result of teaching. Five open-ended questions were prepared by reviewing the relevant literature (Kıryak & Özdilek, 2019; Pabuçcu, 2016) to measure pre-service science teachers' knowledge about acid rain and to determine the effect of teaching. These questions were administered to pre-service science teachers before and after the teaching.

1. How are acid rains formed?
2. What gases cause acid rains?
3. What is the impact of acid rains on the environment?
4. What is the impact of acid rains on living organisms?
5. What can be done to prevent acid rains?

Data Analysis

Descriptive analysis was used in the analysis of open-ended questions. Descriptive analysis is an analytical approach that involves processing qualitative data, identifying findings, and interpreting the identified findings based on a predetermined theoretical framework (Yıldırım & Şimşek, 2016). Codes were created from the responses given by pre-service science teachers to the questions before and after the training, and sample statements for the codes were provided. The analysis of their arguments was conducted using the argumentation assessment rubric developed by Sadler and Fowler (2006). The assessment rubric consists of five levels of argumentation. The levels and explanations of the rubric are shown in Table 1.

Table 1. Argumentation Assessment Rubric (Sadler & Fowler, 2006)

Level	Explanation
0	No justification.
1	Justification with no grounds.
2	Justification with simple grounds.
3	Justification with elaborated grounds.
4	Justification with elaborated grounds and a counterposition.

To ensure the reliability of the data analysis, four randomly selected questionnaires containing open-ended questions were given to a chemistry educator who is an expert in the field. For argument analysis, the same teacher was asked to code the arguments of two groups. The reliability value was determined using the coder reliability formula proposed by Miles and Huberman (1994). The analysis reliability was calculated as 87% and 92% as a result of the calculation.

Results

The findings obtained in the study are presented in response to the research questions. The first section of the findings presents the analysis findings of the responses given by pre-service science teachers to open-ended questions before and after teaching, in response to the first research question. The second section presents the analysis findings of the arguments created by pre-service science teachers in the sociological argumentation activity, in response to the second research question. The findings of the analysis are tabulated, and these tables include the categories obtained according to the analyses and excerpts from the participants' views.

Results Related to the First Research Question

A questionnaire consisting of five open-ended questions was administered to pre-service science teachers before and after instruction. The first question in this open-ended questionnaire asked how acid rain is formed. The pre-service science teacher, who coded PS3, stated that she did not know about this

issue before the instruction. The codes and sample statements created based on the answers given by other pre-service science teachers are presented in Table 2.

Table 2. Pre-service Science Teachers' Views on the Formation of Acid Rain (Pre-Instruction)

Category	Sample Statement	Participants	f	%
Gases	Sulphur dioxide, nitrogen dioxide and carbon dioxide gases released into the atmosphere undergo chemical transformations and are then absorbed by water droplets in clouds. These droplets subsequently fall as rain or snow (PS8).	PS1, PS5, PS7, PS8, PS9, PS10, PS11, PS13	8	61.53
Harmful gases	It refers to the harm caused to the environment and living beings by rain formed when harmful gases combine and mix into the atmosphere due to air pollution. (PS4).	PS2, PS4, PS12, PS14	4	30.77
Chemical rain	Also known as chemical rain.	PS6	1	7.7
Total			13	100

As shown in Table 2, three categories (gases, harmful gases, chemical rain) emerged from the pre-service science teachers' responses regarding the formation of acid rain prior to instruction. Eight pre-service science teachers stated that acid rain is formed as a result of the interaction of sulphur dioxide, nitrogen dioxide and carbon dioxide gases released into the atmosphere with water. Four pre-service science teachers stated that acid rain is formed by the mixing of harmful gases in the atmosphere, but did not mention what these gases are. The pre-service science teacher, who coded PS6, defined acid rain as simply a chemical rain without explaining how it is formed.

Table 3. Pre-service Science Teachers' Views on the Formation of Acid Rain (Post-Instruction)

Category	Sample Statement	Participants	f	%
Fossil fuels	The use of fossil fuels causes harmful gases such as $SO_2(g)$ and $NO_2(g)$, emitted from factory chimneys, to enter the water cycle and fall to the earth as acid rain (PS1).	PS1, PS2, PS3, PS5, PS6, PS7, PS8, PS9, PS10, PS11, PS12, PS13, PS14	13	92.86
pH	These are rains formed by the pH level falling below the normal value of 5.6 due to the gases released into the atmosphere.	PS4	1	7.14
Total			14	100

As shown in Table 3, two categories (fossil fuels, pH) emerged from the pre-service science teachers' responses regarding the formation of acid rain after the training. Thirteen pre-service science teachers' responses fell under the "fossil fuels" category, while one pre-service science teacher's response fell under the "pH" category. After the teaching session, the majority of pre-service science teachers believed that acid rain was caused by the use of fossil fuels and that the gases released as a result of burning these fuels caused acid rain. The pre-service science teacher with the code PS4 stated that acid rain would form as a result of a decrease in the pH value of the atmosphere due to the gases released into the atmosphere.

In the second question of the open-ended questionnaire for pre-service science teachers, they were asked what gases cause acid rain. The codes created based on the responses given by pre-service science teachers before and after the training are presented in Table 4.

Table 4. Pre-service Science Teachers' Views on Gases Causing Acid Rain

Gases	Pre-instruction			Post-instruction		
	Participant	f	%	Participant	f	%
$SO_2(g)$, $SO_3(g)$, SO(x)	PS1, PS2, PS3, PS5, PS6, PS7, PS8, PS9, PS10, PS11, PS12, PS13, PS14	13	34.21	PS1, PS2, PS3, PS4, PS5, PS6, PS7, PS8, PS10, PS11, PS13, PS14	12	46.15
$NO_2(g)$	PS1, PS2, PS5, PS7, PS8, PS9, PS10, PS12, PS13, PS14	10	26.32	PS1, PS2, PS5, PS7, PS8, PS9, PS10, PS11, PS12, PS13, PS14	11	42.31
$CO_2(g)$	PS2, PS3, PS5, PS6, PS7, PS8, PS9, PS11, PS13	9	23.68	PS2, PS3, PS6	3	11.54
Chlorofluorocarbon	PS1, PS3, PS7	3	7.89		-	-
$H_2SO_4(g)$	PS1	1	2.63		-	-
CO(g)	PS2	1	2.63		-	-
$HNO_3(g)$	PS1	1	2.63		-	-
Total		38	100		26	100

Table 4 shows that seven categories were formed from the responses given by the pre-service science teachers before the training, while three categories were formed after the training. It can be seen that the pre-service science teachers indicated that $SO_2(g)$, $SO_3(g)$, and SO(x) gases were the main causes of acid rain both before (f=13) and after (f=12) the training. In second place, both before (f=10) and after (f=11) the training, pre-service science teachers identified NO_2 gas as a cause of acid rain. $CO_2(g)$ gas appeared in third place as a cause of acid rain both before (f=9) and after (f=3) the training. Some pre-service science teachers mentioned chlorofluorocarbon (f=3), $H_2SO_4(g)$ (f=1), CO(g) (f=1) and $HNO_3(g)$ (f=1) gases as the gases causing acid rain before the training.

The third question of the open-ended questionnaire asked pre-service science teachers about the effects of acid rain on the environment. The codes and sample statements created based on the responses given by pre-service science teachers before and after instruction are presented in Table 5.

Table 5. Pre-service Science Teachers' Views on the Environmental Impacts of Acid Rain

Category	Pre-instruction				Post-instruction			
	Sample Statement	Participant	f	%	Sample Statement	Participant	f	%
Impact on historical artefacts	It erodes many architectural structures and historical artefacts (PS9).	PS1, PS3, PS5, PS7, PS8, PS9, PS10, PS11, PS13	9	40.8	Our natural beauty and man-made sculptures and historical artefacts are eroded, causing their structures to deteriorate over time (PS1).	PS1, PS5, PS7, PS8, PS13	5	27.8
Effect on the soil	It damages the soil, reducing yield (PS5).	PS1, PS2, PS3, PS5, PS6, PS9, PS10, PS11	8	36.36	It disrupts the chemical composition of soil and water and reduces their productivity (PS3).	PS1, PS3, PS5, PS6, PS10, PS11	6	33.3

Impact on underground resources	It causes contamination of underground resources (PS6).	PS3, PS4, PS6	3	13.65	Acid rain seeps into the ground, contaminating groundwater and increasing the acidity level of our drinking water sources (PS10).	PS1, PS3, PS5, PS6, PS10, PS11	6	33.3
Toxic effect	It has a toxic effect on living organisms. (PS5).	PS5, PS12	2	9.1	It has a toxic effect on living organisms. It damages the respiratory and immune systems (PS5).	PS2, PS4, PS5, PS6, PS9, PS11, PS12	7	38.9
Total			22	100			18	100

Four categories were established based on the responses of pre-service science teachers regarding the effects of acid rain on the environment before and after training: "effect on historical artefacts", "effect on soil", "effect on underground resources" and "toxic effect". Table 5 shows that, prior to teaching, pre-service science teachers' responses indicated that acid rain had the greatest impact on historical artefacts (f=9) and the least impact on poisoning living organisms (f=2). Looking at the views after instruction, it is understood that the most common view was about the toxic effect of acid rain (f=7), followed by views related to its effect on soil (f=6) and underground resources (f=6). After instruction, fewer pre-service science teachers expressed views regarding the impact of acid rain on historical artefacts (f=5).

The fourth question of the open-ended questionnaire asked pre-service science teachers how acid rain affects living organisms. The pre-service science teacher, who coded PS5, stated that they had no opinion on this question before the instruction. The codes and sample statements created based on the answers given by the pre-service science teachers before and after the instruction are presented in Table 6.

Table 6. Pre-service Sceince Teachers' Views on the Effects of Acid Rain on Living Organisms

Category	Pre-instruction				Post-instruction			
	Sample Statement	Participant	f	%	Sample Statement	Participant	f	%
Effect on human health	Acid rain, which has a detrimental effect on living organisms, also poses a health risk (PS4).	PS1, PS3, PS4, PS7, PS8, PS9, PS10, PS11, PS13	9	69.23	Harmful substances from acid rain originating in the soil first pass into natural food products, and when we consume these products, they disrupt our body's metabolism (PS7).	PS7, PS11, PS13	3	21.43
Impact on biological diversity	It causes harm to fish, their death and a reduction in biological diversity (PS13).	PS3, PS7, PS13	3	23.08	-	-	-	-

Impact on the ecosystem	Due to the contamination of groundwater, it can be transferred through plants and cause harm.	PS6	1	7.69	When the chemical structure of the soil is disrupted, the main structures of plants may be disrupted and they may undergo physical changes.	PS3	1	7.14
Impact on living space	-	-	-	-	It has a negative impact on living organisms because it disrupts their habitats (PS14).	PS1, PS2, PS4, PS5, PS6, PS8, PS9, PS10	10	71.43
Total			13	100			14	100

Regarding the effects of acid rain on living organisms, pre-instruction responses from pre-service science teachers categorised their views into three groups: "effects on human health," "effects on biological diversity," and "effects on ecosystems." Post-instruction responses categorised their views into three groups: "effects on human health," "effects on ecosystems," and "effects on habitats." Table 6 shows that, prior to instruction, pre-service science teachers' responses indicated that they considered acid rain to pose the greatest risk to human health (f=9), followed by a reduction in biological diversity (f=3), and least of all, an impact on the ecosystem (f=1). Looking at the post-instruction views, it is understood that pre-service science teachers most thought that acid rain affected the living environment (f=10), followed by human health (f=3), and least thought that it affected the ecosystem (f=1). Pre-service science teachers did not express any views on the impact of acid rain on living spaces before the instruction, nor did they present any views on its impact on biological diversity after the instruction.

In the fifth question of the open-ended questionnaire for pre-service science teachers, they were asked what could be done to prevent acid rain. The pre-service science teachers with the code PS9 stated that they had no opinion on this question before the training. The codes and sample statements created based on the answers given by the pre-service science teachers before and after the instruction are provided in Table 7.

Table 7. Pre-service Science Teachers' Views on Preventing Acid Rain

Category	Pre-instruction				Post-instruction			
	Sample Statement	Participant	f	%	Sample Statement	Participant	f	%
Use of filters	Filters must be installed on factory chimneys (PS1).	PS1, PS3, PS5, PS6, PS7, PS8, PS10, PS14	8	47.1	We can install filters on the factory chimneys and thus reduce harmful gas emissions (PS14).	PS1, PS4, PS5, PS6, PS7, PS9, PS11, PS14	8	57.14
Awareness raising	The public must be made aware (PS3).	PS3, PS5, PS8, A12	4	23.5	-	-	-	-
Renewable energy sources	Renewable energy sources can be used (PS8).	PS4, PS8, PS13	3	17.7	Renewable energy sources should be used (PS13).	PS2, PS3, PS8, PS10, PS12, PS13	6	42.86
Transport	Public transport and bicycles should be used (PS2).	PS2, PS6	2	11.8	-	-	-	-
Total			17	100			14	100

Four categories were identified from the responses of pre-service science teachers regarding the prevention of acid rain: "use of filters", "awareness raising", "renewable energy sources" and "transport". According to the data in Table 7, similar opinions emerged regarding the "use of filters" category before and after instruction (f=8). Regarding the "awareness raising" category, only four pre-service science teachers stated that public awareness should be raised before instruction, while no opinions were expressed on this subject after instruction. Looking at the "renewable energy sources" category, three pre-service science teachers before instruction and six pre-service science teachers after instruction recommended the use of renewable energy sources. Regarding the "transportation" category, two pre-service science teachers, before instruction, stated that the use of public transport or bicycles in transportation could reduce acid rain; however, no opinions were expressed on this subject after instruction.

Results Related to the Second Research Question

In the third lesson, the pre-service science teachers held discussions on a socio-scientific topic. In this lesson, the students were given the worksheet shown in Figure 2b. The pre-service science teachers were first asked to read the text on the worksheet. They were then asked to form pairs, discuss the topic and present their arguments in a report. The arguments presented by the groups were analysed. The findings of these analyses are presented in Table 8 with sample arguments.

Table 8. Analysis of the Groups' Arguments

Level	Sample Argument	Group	f
0	-	-	-
1	-	-	-
2	We support the people. Historical monuments and healing springs in the district will be damaged. We believe the factory will harm the environment. Most families are farmers. The idea that the factory will not emit toxic gases and the job opportunities. We believe factories will emit toxic gases (G1).	G1 and G5	2
3	We support the residents of the district who oppose the establishment of the factory and believe that it should not be built. The district has historical monuments and medicinal water sources that attract tourists. A significant portion of the district's population earns their livelihood from farming. The gases and pollutants emitted by the factory could erode these historical monuments and contaminate water sources and agricultural land. This situation would negatively impact the region's fundamental economic activities, such as tourism and agriculture. The X Foundation's purpose should be to protect nature. Attempting to recover waste while harming nature itself contradicts the foundation's purpose (G3).	G2, G3 and G6	3
4	We believe that the residents of the district are in the right and argue that this factory should not be built. The main reason for this is that the air and soil pollution caused by the harmful gases emitted by the factory will disrupt the natural balance of the district, threatening the health of the residents, agricultural land and, consequently, their livelihoods. The X Foundation's claim that 'the gases are harmless' is unscientific. Even recycling plants produce gases such as SO_2 and NOx, which can cause acid rain. Filter systems can only reduce this effect, not eliminate it. Therefore, it is unrealistic to say that they are 'harmless'. Furthermore, even if recycling is achieved, this benefit is negligible compared to the damage caused to the environment and people. Factories are man-made structures and inevitably disrupt the natural environment. This is because the construction of a factory alters the natural terrain and vegetation, while its operations lead to increased energy consumption, wastewater, and carbon footprint. In a place like Doğalcık District, which possesses natural and historical values, such damage cannot be tolerated (G4).	G4 and G7	2

Table 8 shows that no group presented arguments at Level 0 or Level 1. This indicates that the pre-service science teachers made minimal claims and defended their claims with at least one justification. The arguments of Group 1 and Group 5 were at Level 2. These groups supported their claims with justifications when presenting their arguments. For example, Group 1 states that the factory will harm the environment and that gas emissions will be harmful, but does not provide supporting or refuting

evidence. The arguments of Groups 2, 3 and 6 are seen to be at Level 3. At this level, the claim, justification and supporting arguments are present, and 3 groups developed arguments at this level. For example, participants in Group 3 stated that the gases emitted from the factory are harmful and will affect the environment, but they have created a stronger argument by providing additional information to support these claims. At the highest level, level 4, there are arguments that include claims, justifications, supporting and refuting arguments. Groups 4 and 7 have presented arguments at this level. For example, Group 4 presented their views that the factory would harm the environment and disrupt the natural balance, supporting their argument with a counterargument that the factory could damage the natural environment despite its claim to support recycling.

Discussion and Conclusion

This study aimed to determine how argument-based teaching methods affect pre-service science teachers' understanding of acid rain and to identify their argument levels on the subject. To this end, a questionnaire consisting of five open-ended questions was administered to pre-service science teachers before and after the teaching. The results obtained from the pre-service science teachers' responses to the open-ended questions before and after instruction are presented below. Furthermore, the results of the argument analysis of the groups in the socio-scientific argumentation activity are presented in this section.

Prior to instruction, the pre-service science teachers were unable to explain the formation of acid rain. In order for the teacher candidates to provide a scientifically acceptable answer, they needed to: (a) know the basic gases involved in the formation of acid rain (SO_2 and NOx), (b) the reaction of these gases with oxygen and water vapour in the atmosphere, and (c) the acids (HNO_3 and H_2SO_4) formed after these reactions (Babuçcu, 2016; p.964). However, the pre-service science teachers did not mention the HNO_3 and H_2SO_4 gases formed as a result of the reaction of the basic (SO_2 and NOx) gases with oxygen and water vapour in the atmosphere. Furthermore, the pH value of acid rain is 5-6 due to the carbonic acid present in the atmosphere (Kant & Kızıloğlu, 2003). The pre-service science teachers did not provide any explanation regarding this information. This situation indicates that pre-service science teachers have limited knowledge about acid rain prior to teaching. Similar findings exist in the literature (Babuçcu, 2016; Köklükaya & Güven Yıldırım, 2016; Majer et al., 2019). Research conducted by Majer and colleagues showed that many students had insufficient knowledge about specific pollutants responsible for acid rain, such as NOx and SOx. After the training, the explanations of the majority of pre-service science teachers regarding the formation of acid rain became more scientific and specific. When explaining acid rain, pre-service science teachers mentioned the role of fossil fuels, the chemical processes of acid rain, and its relationship with pH value. This indicates that after the argumentation-based teaching process, pre-service science teachers better understood the chemical processes of acid rain and its connection to fossil fuels.

Regarding the gases that cause acid rain, the pre-service science teachers mentioned gases such as $SO_2(g)$, $SO_3(g)$, (SOx), $NO_2(g)$, $CO_2(g)$, CO(g), and chlorofluorocarbons (CFCs) before the training, but after the training, they only mentioned $SO_2(g)$, $SO_3(g)$, (SOx), $NO_2(g)$, and $CO_2(g)$. After teaching, it was observed that the pre-service science teachers' misconceptions about gases such as chlorofluorocarbons (CFCs) and CO(g) causing acid rain had disappeared. Pabuçcu (2016) determined that students saw CO2 gas as one of the main causes of acid rain, while Ürey et al. (2011) determined that teacher candidates mentioned carbon monoxide, nuclear waste, and chlorofluorocarbon (CFC) gases among the gases that cause acid rain. These results demonstrate that the teaching process is effective in reducing misconceptions about the subject and increasing scientific accuracy.

Regarding the impact of acid rain on the environment, 40.8% of pre-service science teachers mentioned the corrosive effect of acid rain on historical artefacts before instruction. However, this percentage decreased to 27.8% after instruction. This decrease may indicate that, after the teaching process, pre-service science teachers began to approach the environmental effects of acid rain from a broader perspective and that their awareness of other environmental areas, in addition to historical artefacts, increased. Before teaching, 36.36% of pre-service science teachers stated that acid rain harms the soil and reduces its fertility. After the teaching process, this rate decreased to 33.3%. Although these rates remained close to each other, the pre-service science teachers provided more detailed explanations

about the chemical structure of the soil after the teaching process. Before the teaching process, 13.65% of the participants stated that acid rain polluted underground resources, while after the teaching process, this rate increased to 33.3%. This increase indicates that pre-service science teachers' awareness of the effects of acid rain on water resources significantly increased after the teaching process. The percentage of pre-service science teachers who mentioned toxic effects, which was 9.1% before teaching, rose to 38.9% after teaching. After the training, pre-service science teachers mentioned that acid rain could have toxic effects on living organisms and could also damage the respiratory and immune systems. This suggests that pre-service science teachers gained more knowledge about the biological effects of acid rain as a result of the training. Similar findings regarding students' views on the environmental impact of acid rain are available in the literature (Buldur et al., 2018; Çelikler & Harman, 2015; Demirbaş & Pektaş, 2009).

Regarding the impact of acid rain on living organisms, 69.23% of pre-service science teachers mentioned the negative effects of acid rain on human health before the training. After the training, this rate decreased to 21.43%. Pre-service science teachers also focused on other environmental and ecological effects of acid rain after the training. Before the training, 23.08% of pre-service science teachers mentioned that acid rain negatively affected biodiversity. However, after the training, no opinions were expressed in this category. This situation may stem from the training process directing pre-service science teachers towards more general ecosystem and habitat effects rather than biodiversity. The view that acid rain negatively affects the ecosystem was expressed by 7.69% of pre-service science teachers before teaching and 7.14% after teaching. Pre-service science teachers generally stated that acid rain could have harmful effects on plants by disrupting the chemical structure of the soil. 71.43% of pre-service science teachers stated after the training that acid rain disrupts the habitats of living organisms. Overall, it is seen that after the training, pre-service science teachers evaluated the effects of acid rain from a broader environmental perspective rather than solely in the context of human health. Similar findings regarding student views on the effects of acid rain on living organisms are available in the literature (Babuçcu, 2016; Buldur et al., 2018; Ürey et al., 2011).

Regarding the prevention of acid rain, the most frequently emphasised view before teaching was the necessity of installing filters on factory chimneys, with 47.1% of pre-service science teachers expressing this view. After teaching, this view rose to 57.14%. The idea of using renewable energy sources was expressed by 17.7% before the training, while this figure rose to 42.86% after the training. The training process appears to have increased awareness of environmentally friendly solutions, particularly the use of filters and renewable energy sources. In contrast, suggestions regarding public awareness and the use of public transport and bicycles were not expressed after the training. However, there was a decrease in some categories such as transport and awareness, which may indicate that pre-service science teachers focused on different solutions. At the end of the training, measures that directly affect the environment, such as the use of renewable energy sources and the installation of filters, came to the fore. These findings show that active teaching methods such as environmental education and argumentation increase pre-service science teachers' capacity to develop solutions to environmental problems and contribute to more conscious thinking. Köklükaya and Güven Yıldırım (2016) stated that pre-service science teachers did not have sufficient knowledge about the measures that could be taken to mitigate the effects of acid rain. Kıryak and Özdilek (2019) stated that among the suggestions made by eighth-grade students to prevent acid rain, the most common were the use of public transport and the installation of filters on factory chimneys.

Summers et al. (2001) investigated the understanding of primary and secondary school students in the UK regarding environmental issues, including acid rain. They found that most students believed acid rain was caused solely by car pollution or was directly linked to visible acid in the rain. The researchers suggested that students' misconceptions stemmed from the lack of clear teaching of the chemical reactions involved in acid rain formation, recommending that the science curriculum include clearer and more detailed explanations of pollution sources and chemical processes. Ramadhani et al. (2022) investigated the effectiveness of augmented reality-based learning environments in teaching about acid rain, emphasising that innovative educational tools can enhance students' engagement with and understanding of complex environmental issues. This indicates the need for practical experiments in chemistry education to demonstrate the principles of acid rain and its effects on the environment. Such

experiential learning opportunities can enhance students' understanding of acid rain by helping them relate theoretical knowledge to real-world applications (Goss, 2003). Khalid (2003), stating that the lack of context-based learning contributes to the disconnect between theoretical knowledge and real-world applications, indicates that real-world environmental case studies should be integrated into science lessons to develop conceptual understanding. Furthermore, discussion environments that relate theoretical knowledge to real-world applications in these lessons will enable students to better understand abstract and complex concepts. Collaborative learning environments have also been shown to positively influence students' concepts about acid rain. Marinopoulos and Stavridou (2002) found that students' understanding of acid rain improved significantly when they participated in collaborative discussions. This suggests that fostering a collaborative classroom atmosphere can develop students' critical thinking and problem-solving skills regarding environmental issues. In teaching the topic of acid rain, interdisciplinary teaching that combines chemistry and environmental science should be encouraged to better contextualise acid rain within ecological systems. Özcan and Demirel (2019) recommend organising field trips to authentic learning environments such as botanical and ecological gardens, factories, and industrial facilities as part of environmental education. Bulduk (2024) states that, considering the resources available to schools, teacher candidates should be presented with examples of enriched activities that combine different methods and techniques. In this regard, it is recommended that these methods be combined and disseminated in teacher education to develop a more effective approach to environmental issues.

When examining the argument levels of the groups regarding acid rain, it was determined that they wrote arguments at levels 2 and 3. This situation demonstrates that pre-service science teachers use argument components such as supporting evidence, justification, backing and refuting arguments when defending their claims regarding acid rain.

In light of the results obtained, it is evident that innovative teaching methods and more comprehensive environmental education programmes are necessary and important to increase the level of understanding of acid rain as an environmental issue among students and pre-service science teachers. It has been found that argument-based teaching methods on acid rain enable students to better understand scientific concepts and develop their environmental awareness and critical thinking skills. The use of active learning methods such as argumentation in teacher training programmes will ensure that teacher candidates have sufficient knowledge on environmental education topics, enhance their critical thinking skills, and develop their understanding of the subject. It is anticipated that the wider application of this method in science education will increase student achievement and scientific literacy. Therefore, it is recommended that argumentation-based activities be planned and implemented both in science classes and in subject-specific training courses for pre-service science teachers. Furthermore, by using the argumentation method, pre-service science teachers will be able to create learning environments based on scientific discussions and easily manage scientific debates when they become teachers.

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Öğretmen Adaylarının Web 2.0 ve Web 2.0 Araçları Hakkındaki Düşünceleri[1]

Prospective Teachers' Opinions about Web 2.0 and Web 2.0 Tools

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Özet: Bu çalışmanın amacı, öğretmen adaylarının Web 2.0 ve Web 2.0 araçları hakkındaki düşüncelerinin belirlenmesidir. Çalışmada nitel araştırma yöntemlerinden durum çalışması deseni kullanılmıştır. Çalışma grubu, 2023-2024 eğitim-öğretim yılında Balıkesir Üniversitesi Necatibey Eğitim Fakültesinde (Türkiye) son sınıfta öğrenim gören 100 öğretmen adayından oluşmaktadır. Veri toplama araçları, Web 2.0 Kelime İlişkilendirme Formu ve Web 2.0 Yazılı Görüş Formudur. Veri analizi; içerik analizi yöntemine göre yapılmış olup, sorulara verilen cevaplar kod, kategori ve tema olarak gruplandırılmıştır. Çalışmada öğretmen adaylarının Web 2.0 kavramı ile ilgili toplam 400 anlamlı kavram/kelime ile ilişkilendirdikleri ve Web 2.0 kavramı ile ilgili toplam 91 anlamlı cümle yazdıkları tespit edilmiştir. Öğretmen adaylarının Web 2.0'ı en çok "teknoloji, İnternet ve Canva" ile ilişkilendirdikleri ve Web 2.0 ile ilgili en fazla "eğitim, kolaylık ve teknoloji" ile ilgili cümle kurdukları belirlenmiştir. Öğretmen adaylarının Web 2.0 tanımı ile ilgili öne çıkan kodları şunlardır: "Kolaylık, teknoloji ve eğitim".Öğretmen adaylarının en fazla bildiği Web 2.0 araçları "Canva, Kahoot, Wordwall ve YouTube", en çok kullandıkları Web 2.0 araçları "Canva, Kahoot ve Teams" tir. Öğretmen adayları, derslerde "Canva, Wordwall, Kahoot ve Teams" i en çok kullanışlı Web 2.0 aracı olarak görmektedirler. Öğretmen adayları lisans programlarında Web 2.0'ın en çok "derslerde verildiğini, uygulamalarda kullanıldığını, bununla ilgili ödevlerin verildiğini ve PowerPoint/sunumlarda kullanıldığını" belirtmişlerdir. Öğretmen adayları Web 2.0'ın gelecekte derslere entegrasyonu konusunda bunun en çok okulda "derslerde, etkinlik hazırlamada, Web 2.0 araçlarının kullanılmasında ve ölçme-değerlendirmede" yapılabileceğini ifade etmişlerdir.

Anahtar Kelimeler: Web 2.0, Web 2. 0 araçları, kelime ilişkilendirme formu, yazılı görüş formu, öğretmen adayları

Abstract: The purpose of this study was to examine the prospective teachers' opinions about Web 2.0 and Web 2.0 tools. In the study, case study design, one of the qualitative research methods, was used. The study group included 100 prospective teachers studying in the senior year at Balıkesir University Necatibey Faculty of Education in Türkiye in the 2023-2024 academic year. Data collection tools were Web 2.0 Word Association Form and Web 2.0 Written Opinion Form. Data were analyzed by content analysis method, and the answers to the questions were grouped by codes, categories and themes. In the study, it was determined that the prospective teachers associated a total of 400 meaningful concepts/words with the concept of Web 2.0 and wrote a total of 91 meaningful sentences about the concept of Web 2.0. The prospective teachers mostly linked Web 2.0 with "technology, Internet, and Canva" and the prospective teachers mostly wrote sentences related to "education, convenience, and technology" regarding Web 2.0. Their prominent codes related to the definition of Web 2.0 were: "Convenience, technology and education".The Web 2.0 tools that the prospective teachers knew most were "Canva, Kahoot, Wordwall, and YouTube", and the Web 2.0 tools they used most were "Canva, Kahoot, and Teams". The prospective teachers saw "Canva, Wordwall, Kahoot, and Teams" as the most useful Web 2.0 tools in classes. They stated that Web 2.0 is mostly "taught in classes, used in application, given homework related to it, and used in PowerPoint/presentations" in undergraduate programs. Regarding the integration of Web 2.0 into future classes, the prospective teachers stated that this could mostly be done at school "in lessons, preparing activities, using Web 2.0 tools, and measurement-evaluation".

Key Words: Web 2.0, Web 2.0 tools, word association form, written opinion form, prospective teachers

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Giriş

21. yy. da gün geçtikçe gelişen ve değişen teknolojiler her alanda değişikliklere yol açmaktadır. Bu alanlardan biri de eğitimdir (Ünlüer, 2018). Eğitim alanında öğretmenlerin ve öğretmen adaylarının ders anlatırken, ödev verirken ya da ders içi etkinliklerini oluştururken vb. kullandıkları pek çok dijital ve teknolojik araç vardır. Bunlardan biri de Web 2.0 araçlarıdır.

YouTube, Instagram, Canva, Kahoot gibi pek çok Web 2.0 aracı bulunmaktadır. Web 2.0 araçları çeşitli amaçlarla kullanılan uygulama ve sitelerdir. Örneğin, bunlar bazı uygulamalarda videolar birleştirilirken veya fotoğraflardan oluşan anılar video haline getirilirken, ödev hazırlarken, okullarda etkinlik yapılırken, ev, iş veya kişisel ihtiyaçlar için alışveriş yapılırken vb. kullanılabilirler. Böylece, dinamik ve etkileşimli bir çevrimiçi ortam oluşturan Web 2.0 teknolojileri ile bulut bilişim entegrasyonu işletmelere uygun maliyetli çözümler sağlamıştır (Dixit, 2024). Eğitimde, iş birliğine dayalı araçlar ve sanal öğrenme ortamları, geleneksel öğretim yöntemlerini yeniden tanımlayarak küresel bağlantıyı ve bilgi alışverişini teşvik etti.

Web 2.0 araçlarının kullanımı gün geçtikçe artarken, bu araçların kullanılmasının öğrenilmesi de önem arz etmektedir. Bu kadar geniş alana sahip bu araçları derslerde kullanabilmek için hem öğrencilerin hem de öğretmenlerin bu araçlar hakkında bilgi sahibi olması gerekmektedir. Derslerde kullanılmak üzere seçilen Web 2.0 araçları dersin içeriği, kazanımları ve yapılacak etkinliklerine uygun olarak belirlenmelidir (Timur vd., 2020). Şekil 1'de Web 2.0 araçları sınıflandırılması verilmiştir (Elmas & Geban, 2012).

Şekil 1. Web 2.0 araçları sınıflandırması (Elmas & Geban, 2012)

Literatürde öğretim üyeleri, öğretmenler ve öğretmen adaylarının Web 2.0 hakkında görüşlerini içeren pek çok çalışma bulunmaktadır. Örneğin, Ahmed vd. (2025) Sudan'daki eğitim fakültesinde öğretim üyelerinin derslerinde Web 2.0 araçlarını kullanma durumları üzerine yaptıkları çalışmada şu sonuçları elde etmişlerdir: Öğretim üyelerinin Web 2.0 araçlarını üniversitede kullanma düzeyleri orta düzeyde olup, Web 2.0 araçlarını en çok bilimsel araştırma konularında kullanmaktadırlar. Bunun yanında, öğretim üyelerinin Web 2.0 kullanama düzeyleri lisans düzeyinde anlamlı bir fark göstermezken, bölüm bazında anlamlı bir fark göstermiştir. Ancak üniversite öğretmenleri öğretimde Web 2.0 kullanımının bazı zorluklara yol açtığını belirtmişlerdir.

Akbaş ve Yünkül (2024) çalışmalarında, öğretmenlerin Web 2.0 araçlarını derslerin tüm aşamalarında kullandıklarını ifade etmelerine rağmen, öğretmenlerin Web 2.0 araçlarının kullanımı esnasında çoğunlukla donanım eksikliği, İnternet bağlantı sorunları, sınırlı erişim ve güncelleme problemleri yaşandığını belirtmişlerdir. Serin (2024) sınıf öğretmenlerinin matematik derslerinde Web 2.0 araçlarının kullanılmasında yaşanan başlıca problemlerin teknik problemler ve zamanın iyi ayarlanamaması olduğunu vurgulamıştır. Kayar (2019) çalışmasında, lise İngilizce öğretmenlerinin Web 2.0 araçlarını sınıfta kullanılmalarının dezavantajlarını şöyle sıralamıştır: Web 2.0 araçları zaman alıcıdır, İnternet bağlantısı gerektirmektedir ve sınıf yönetimi problemlerine neden olmaktadır. Özpınar (2020) çalışmasında, Web 2.0 araçlarının kullanılmasında İnternet ve teknolojik araç gereksiniminin öğretmen adayları tarafından önemli bir sınırlılık olduğu rapor edilmiştir.

Taşlıçay Arslan (2019) çalışmasında şu sonuçlar göze çarpmaktadır: Web 2.0 araçlarının tanıtımı sonrasında öğretmen adaylarının öğretim teknolojisi standartları özyeterliği ve öğretim teknolojisine yönelik tutumlarında artışa neden olmuştur. Usta vd. (2020) "öğretmen adaylarının öğrenme ortamına Web 2.0 teknolojilerini entegre edebilme yeterliliği" isimli çalışmalarında şu sonuçlara ulaşmışlardır: Web 2.0 araçlarının öğrenme ortamına entegrasyon edilebilme düzeyinin %12,77'si yeterli; %72,34'ü kısmen yeterli ve %14,89 yetersizdir. Çalışmadaki veri toplama aracı, öğretmen adaylarına 35 kategoride sınıflanan Web 2.0 araçlarının bulunduğu bir bilgi toplama formudur. Serin (2024) sınıf öğretmenlerinin matematik derslerinde Web 2.0 araçlarını orta sıklıkta kullandıklarını rapor etmiştir. En çok tercih edilen Web 2.0 araçlarının başında gelen Wordwall, Quizizz ve Kahoot'un tercih sebebinin ise bu araçların dersleri eğlenceli hale getirmesi olduğu belirtilmiştir.

Kuloğlu vd. (2024) çalışmasında; öğretmen adaylarının Web 2.0 araçlarını kullanma yetkinliğinin orta düzeyde olduğunu belirlemiştir. Öğretmen adaylarının Web 2.0 kullanım yetkinlikleri cinsiyet, sınıf, internette geçirilen süre, anne ve baba eğitim durumları değişkenleri açısından anlamlı bir farklılık göstermezken, bölüm olarak Sosyal Bilgiler, Okul Öncesi ve İngilizce Bölümleri lehine anlamlı bir farklılık bulunmuştur. Ayrıca, çalışmada 1 ve 2 kardeş sayısına sahip öğretmen adaylarının Web 2.0 araçlarını kullanma yetkinliklerinin çok daha yüksek olduğu saptanmıştır. Diğer örnek ise, "Sosyal Bilgiler ile Bilgisayar ve Öğretim Teknolojileri öğretmeni adaylarının eğitimde Web 2.0 kullanımına yönelik görüşleri" dir (Özer & Albayrak, 2017). Veriler, yarı yapılandırılmış görüşme formu ile toplanmış olup, araştırmada şu sonuçlara ulaşılmıştır: Öğretmen adayları; Web 2.0 özelliklerinin kısmen farkındadırlar ve Web 2.0 araçlarını eğitimde kullanmak istemekle birlikte,bu konudaki bilgileri yeterli değildir. Karakuş ve Er (2021) "Türkçe öğretmeni adaylarının Web 2.0 araçlarının kullanımıyla ilgili görüşleri" adlı makalelerinde öğretmen adaylarının Web 2.0 araçlarını ne kadar bildiği ve nasıl kullandıklarını araştırmışlardır. Çalışma, nitel araştırma yöntemlerinden durum çalışması yöntemi kullanılarak yürütülmüştür. Veriler, Google Forms üzerinden 16 maddelik yazılı görüş formu hazırlanarak toplanmıştır. Çalışmada öğretmen adaylarının Web 2.0 araçlarının bazılarını bildiği ve bazılarını da kullandıkları tespit edilmiştir.

Sonuç olarak, öğretim üyeleri, öğretmenler ve öğretmen adaylarının Web 2.0 hakkında bilgileri ve kullanma düzeyleri orta düzeyde bulunmuştur. Bunun yanında, Web 2.0 kullanımının bazı zorluklara yol açtığını belirtmişlerdir. Örneğin, teknik problemler, zamanın iyi ayarlanamaması, İnternet bağlantısı sorunu gibi.

Bu araştırmanın amacı, öğretmen adaylarının Web 2.0 ve Web 2.0 araçları ile ilgili görüşlerini belirlemektir. Literatürde öğretmen adaylarının Web 2.0 araçları hakkındaki düşüncelerini inceleyen pek çok çalışma bulunmasına rağmen (Ahmed vd., 2025; Karakuş & Er, 2021, Özpınar, 2020; Serin, 2024), Web 2.0 ve Web 2.0 araçlarını Kelime İlişkilendirme Formu (KİF) ile inceleyen bir çalışmaya rastlanamamıştır. Bu nedenle, bu çalışma sonuçlarının Web 2.0 ile ilgili literatüre katkı sağlayacağı düşüncesindeyiz. Bu doğrultuda aşağıdaki alt problemlere cevap aranmıştır:

1. Öğretmen adaylarının Web 2.0 kelimesi ile ilgili bilişsel yapıları nasıldır?
2. Öğretmen adayları Web 2.0'ı nasıl tanımlamaktadırlar?
3. Öğretmen adaylarının ismini bildikleri ve kullanmasını bildikleri Web 2.0 araçları nelerdir?
4. Öğretmen adaylarının Web 2.0 araçlarının lisans derslerinde verilişi ve kullanılışı hakkındaki düşünceleri nelerdir?

5. Öğretmen adaylarının Web 2.0 araçlarının gelecekte derslere entegrasyonu hakkındaki düşünceleri nelerdir?

Yöntem

Araştırma Modeli

Araştırmada, nitel araştırma yöntemlerinden durum çalışması deseni kullanılmıştır. Durum çalışması, belli bir durum veya olayı incelemek amacıyla yapılan nitel araştırma yöntemlerinden biridir (Büyüköztürk vd., 2013; Özenç, 2022).

Çalışma Grubu

Çalışma grubunu, 2023-2024 eğitim-öğretim yılında Balıkesir Üniversitesi Necatibey Eğitim Fakültesinde son sınıfta öğrenim gören 100 öğretmen adayı oluşturmaktadır. 100 öğretmen adayının 19'u Biyoloji Öğretmenliği, 13'ü Türkçe Öğretmenliği, 22'si Fen Bilimleri Öğretmenliği, 2'si Müzik Öğretmenliği, 2'si Matematik Öğretmenliği ve 42 tanesi diğer öğretmenlik bölümlerinden oluşmaktadır. Araştırmanın çalışma grubu belirlenirken ölçüt örnekleme yöntemi kullanılmıştır (Büyüköztürk vd., 2013). Burada ölçüt, Balıkesir Üniversitesi Necatibey Eğitim Fakültesinde öğrenim gören öğretmen adaylarının son sınıf öğrencisi olmalarıdır. Çünkü öğrenciler son sınıfa gelinceye kadar Web 2.0 araçlarına aşina olmakta, bununla ilgili birkaç ders almakta ve farklı derslerde bunların hem kullanıldığını görmekte hem de kendileri kullanmaktadırlar.

Veri Toplama Araçları

Araştırma verileri, araştırmacılar tarafından geliştirilen Web 2.0 Kelime İlişkilendirme Formu (KİF) ve Web 2.0 Yazılı Görüş Formu kullanılarak toplanmıştır. Web 2.0 KİF öğretmen adaylarının Web 2.0 ile ilgili hangi kelime/kavramları çağrıştırdığını belirlemek için ve Web 2.0 Yazılı Görüş Formu ise öğretmen adaylarından Web 2.0 ve Web 2.0 araçları hakkında daha fazla bilgi almak için geliştirilmiştir.

Web 2.0 KİF'te öğretmen adaylarından önce 30 saniye içinde Web 2.0 ile ilgili akıllarına gelen ilk 5 kelime/kavramı sırasıyla alt alta gelecek şekilde verilen boşluklara yazmaları ve daha sonra yine 30 saniye içinde Web 2.0 ile ilgili bir cümle yazmaları istenmektedir (Özatlı & Bahar, 2010). Web 2.0 Yazılı Görüş Formu ise, yedi açık uçlu sorudan oluşmaktadır. İki form da öğretmen adaylarına Google Forms aracılığıyla gönderilmiştir.

Veri Analizi

Veriler, içerik analizi tekniği kullanılarak analiz edilmiştir. Web 2.0 KİF ve Web 2.0 Görüş Alma Formuna verilen cevaplar, araştırmacılar tarafından önce Excel'e aktarılmıştır. Daha sonra, her iki formdaki her soruya verilen cevaplar kod, kategori ve temalara ayrılmıştır. En son, bunlara ilişkin frekans tabloları oluşturulmuştur (Yıldırım & Şimşek, 2006). Bir tabloda her öğrencinin bu soruya verdiği cevaplar birden fazla kod içerebilir. Bu nedenle, bazen bir tabloda toplam frekans 100'ü geçebilmektedir. Ayrıca, ilginç öğrenci cevaplarına örnekler " … " aynen alıntı yapılarak metin içinde verilmiştir. Kodlayıcılar arası güvenirlik, makale yazarları tarafından sağlanmıştır.

Bulgular

Web 2.0 kelimesi ile ilgili bilişsel yapı

Web 2.0 kelimesinin öğretmen adaylarına çağrıştırdığı kelime ve kavramlara ilişkin bulgular Tablo 1'de sunulmuştur.

Tablo 1. Web 2.0 kelimesiyle ilişkili kelime ve kavramlar

Tema	Kategori	Kod	f
Teknoloji (400)	Web 2.0 Araçları (178)	Canva	28
		Kahoot	20
		Wordwall	20
		YouTube	18
		Learning Apps.	13
		Teams	9
		Socrative	8
		Prezi	7
		Zoom	6
		Google	6
		Quizizz	4
		Facebook	3
		Wikipedia	3
		Blog	2
		Edmodo	2
		Geogebra	2
		Google forms	2
		Google meet	2
		StoryJumper	2
		Actionbound	2
		Baamboozle	2
		Capcut	2
		ClassDojo	1
		Diagrams	1
		Draw.io	1
		Edpuzzle	1
		Emaze	1
		Gimkit	1
		Go Math	1
		Googlemap	1
		Instagram	1
		Mentimeter	1
		Midjourney	1
		Pheeting	1
		Snapchat	1
		Thinglink	1
		WordPress	1
	Bilgisayar (122)	Teknoloji	38
		Bilgisayar	15
		PowerPoint/Sunum	13
		Word	10
		Uygulama	8
		Excel	5
		Araç	4
		Bilişim	4
		Araştırma	3
		Yazılım	3
		Ağ	2
		Dosya	2
		Sistem	2
		Tarayıcı	2
		Yapay zeka	2
		Chat	2
		Arama motoru	1
		Bilişim teknolojileri araçları	1
		Güncelleme	1
		Kodlama	1
		Pdf	1

	Photoshop	1
	Html5	1
İnternet (51)	İnternet	32
	Online/Çevrimiçi	4
	Hız	4
	Sosyal medya	3
	Erişim/Hızlı erişim	2
	Gezinti/Dolaşım	2
	Dijital ortam	1
	Dijital sınıf ortamı	1
	Güç	1
	Hızlı bilgi	1
Özellik (25)	Yenilik/Yenilikçilik/İnovasyon	9
	Beceri/Yetkinlik/21. yy. becerileri	3
	Etkileşim	2
	Kullanışlılık	2
	Dikkat çekici	1
	Eğlence	1
	Ekonomiklik	1
	Entegrasyon	1
	Görsellik	1
	İleriye dönük	1
	İletişim aracı	1
	Yaratıcılık	1
	Yarışma	1
Eğitim-Öğretim (24)	Uygulama	8
	Oyun	3
	Öğretim materyali/Öğretme aracı	2
	Öğrenme/Öğrenim	2
	Sınıf/Sınıf katılımı	2
	Oyunla öğrenme	1
	Öğrenci	1
	Öğreticilik	1
	Soru	1
	Dijital okuryazarlık	1
	Anket	1
	Çalışma	1

Tablo 1'de verilen Web 2.0 KİF'in kelime kısmı bulgularına göre (toplam 400 anlamlı kavram/kelime; anlamsız/ilgisiz kelime 6, cevap yok 5), öğretmen adaylarının Web 2.0'ı en çok "teknoloji (38), İnternet (32) ve Canva (28)" ile ilişkilendirdikleri tespit edilmiştir. Bu soruya anlamsız/ilgisiz yanıt veren öğrenci sayısı 6 iken, 6 öğrencinin de bu soruya cevap vermediği gözlenmiştir.

Web 2.0 Kelime İlişkilendirme Formunun cümle kısmı bulguları Tablo 2'de gösterilmektedir.

Tablo 2. Web 2.0 kelimesi ile ilgili cümleler

Tema	Kategori	Kod	f
Teknoloji (46)	Bilgisayar (16)	Teknoloji	8
		PowerPoint/Sunum	3
		Yapay zeka	1
		Sistem	1
		Microsoft	1
		Yazılım	1
		Araç	1
	İnternet (9)	İnternet	7
		Web/Site	2
	Özellik (21)	Kolaylık	13
		Yararlı/Verimli	6
		İletişim	1
		Ekonomik	1
Eğitim-Öğretim (45)	Eğitim-Öğretim (45)	Eğitim	14
		Öğrenme	7
		Öğretim	6
		Ders	6
		Bilgi	3
		Ölçme	3
		Etkinlik	3
		Eğitici	3

Tablo 2'de verilen Kelime İlişkilendirme Formu cümle kısmı sonuçlarına göre (toplam 91 anlamlı cümle, anlamsız/ilgisiz cümle 4, cevap yok 5), öğretmen adaylarının Web 2.0 araçları ile ilgili en çok "eğitim (14), kolaylık (13) ve teknoloji (8)" ile ilgili cümle kurdukları belirlenmiştir. Burada 4 öğrenci Web 2.0 ile ilgili anlamlı olmayan cümle kurarken, 5 öğrenci ise Web 2.0 ile ilgili cümle yazmamıştır.

Kategori: Eğitim-öğretim

Eğitim-öğretime yardımcı uygulamalar. (Ö8)
Eğitimde eğlenceyi ve eğitimi bir arada kullanan teknolojik araçlardır. (Ö17)
Dersi pekiştirmenin en iyi yolu (Ö15)
Web 2.0 güzel etkinlikler tasarlayarak, güzel sunumlar yapmamıza yarayan araçları kapsar. (Ö49)

Kategori: Bilgisayar

Teknolojiyi temele alan araçları kapsar. (Ö6)
Sunum araçlarından Prezi ile ödev hazırladım. (Ö22)

Kategori: Verimlilik

Öğrenciler için yararlı bir uygulama ve öğrencilere dersi oyunla sevdirdiğini düşünüyorum. (Ö4)
Ekonomik bir etkinlik (Ö42)

Kategori: İnternet

Bireylere bazı kullanım alanlarında kolaylık sağlayan internet siteleridir. (Ö26)

Web 2.0 tanımı

Öğretmen adaylarının Web 2.0 tanımına ait bulguları Tablo 3'te verilmiştir.

Tablo 3. Web 2.0 tanımı

Tema	Kategori	Kod	f
Tanım (80)	Bilgisayar (23)	Teknoloji	10
		Etkileşim	6
		Yazılım	3
		Sunum	1
		Yapay zeka	1
		Edit	1
		Uygulama	1
	İnternet (9)	İnternet	8
		Sanal ortam	1
	Özellik (23)	Kolaylık	11
		İletişim	8
		Fayda	2
		Paylaşım	2
	Eğitim-Öğretim (25)	Eğitim	9
		Etkinlik	5
		Öğrenme	4
		Eğitici oyun	3
		Öğretim	1
		Ders	1
		Bilgi	1
		Ölçme	1

Tablo 3'e göre, pek çok öğretmen adayının Web 2.0 tanımını tam olarak bilmediği daha kısa tanımlar yaptıkları tespit edilmiştir. Öğretmen adayları tarafından yapılan Web 2.0 tanımı, en çok "özellik, bilgisayar ve eğitim-öğretim" kategorilerinde toplanmıştır. Bu kategorilerdeki en yüksek kodlar şunlardır: "Kolaylık (11), teknoloji (10) ve eğitim (9)". Bu soruya anlamsız/ilgisiz yanıt veren öğrenci sayısı 5 iken, 15 öğrencinin de bu soruya cevap vermediği gözlenmiştir.

Kategori: Eğitim-öğretim

Eğitim hayatımızı daha aktif bir şekilde geçirmemizi sağlayan bir uygulamadır. (Ö96)
Teknoloji ile bütünleşen öğretim ortamı. (Ö68)
Okulda gerekli etkinlikler yapmamıza yardımcı program. (Ö43)
Konuları eğitici oyunlarla öğretmek. (Ö88)

Kategori: Bilgisayar

Günümüzde öne çıkan teknoloji temelli araçlardır. (Ö6)
Web 2.0 araçları sunum yapmak için harika bir ortam. (Ö85)

Kategori: Verimlilik

Hayatımızı kolaylaştıran eğitimde özellikle teknolojik uygulamalar. (Ö5)
Online araçlardan faydalanabilme. (Ö92)

İsmi bilinen ve kullanılması bilinen Web 2.0 araçları

Öğretmen adaylarının ismini bildikleri ve kullanmayı bildikleri Web 2.0 araçları Tablo 4 ve Tablo 5'te verilmiştir.

Tablo 4. İsmi bilinen Web 2.0 araçları

Tema	Kategori	Kod	f
Teknoloji (84)	Web 2.0 Araçları (84)	Canva	24
		Kahoot	19
		Wordwall	10
		YouTube	10
		Teams	7
		Prezi	3
		Instagram	3
		Google	2
		Facebook	2
		Photostory	1
		Geogebra	1
		Chat GPT	1
		StoryJumper	1

Tablo 4'e göre, öğretmen adaylarının 14 adet Web 2.0 aracını bildiği tespit edilmiştir. Öğretmen adaylarının ismini en çok bildikleri Web 2.0 araçları ise, "Canva (24), Kahoot (19), Wordwall (10) ve YouTube (10)" dur. Ayrıca, bazı öğretmen adayları bu soruya anlamsız/ilgisiz (6) yanıtlar verirken, bazıları da bilmiyorum diye yanıt vermişlerdir (10).

Tablo 5. Kullanılışı bilinen Web 2.0 araçları

Tema	Kategori	Kod	f
Teknoloji (69)	Web 2.0 Araçları (69)	Canva	18
		Kahoot	16
		Teams	10
		YouTube	7
		Wordwall	6
		Prezi	4
		Learning Apps.	4
		Instagram	3
		Geogebra	1

Tablo 5 öğretmen adaylarının kullanmasını bildikleri Web 2.0 araçları ile ilgili bulguları özetlemektedir. Buna göre, öğretmen adaylarının toplamda 13 Web 2.0 aracını kullanmayı bildikleri, bunlardan da en çok "Canva (18), Kahoot (16) ve Teams (10)" u kullanmayı bildikleri tespit edilmiştir. Ayrıca, bu soruya anlamsız/ilgisiz (8) yanıt verenler ve hiç cevap vermeyenler (13) bulunmaktadır.

Web 2.0 Araçlarının Lisans Derslerinde Verilişi ve Kullanılışı

Öğretmen adaylarının Web 2.0 araçlarının lisans derslerinde verilişi ve kullanılışına ait bulgular Tablo 6 ve Tablo 7'de sunulmuştur.

Tablo 6. Web 2.0 araçlarının lisans derslerinde verilişi

Tema	Kategori	Kod	f
Öğretim (83)	Derste Veriliş Şekli (72)	Dersler verildi.	45
		Uygulamalar kullanılıyor.	6
		Ödevler veriliyor.	6
		PowerPoint/Sunumlarda kullanılıyor.	5
		Etkinlikte kullanılıyor.	3
		İnternet	2
		Konu anlatımında kullanılıyor.	1
		Müzik notası yazımında kullanılıyor.	1
		Poster hazırlamada kullanılıyor.	1
		Uygulamalar hakkında bilgi verildi.	1
		Ölçme-değerlendirmede kullanılıyor.	1
	Eğitim-Öğretim (8)	Eğitim	3

	Öğrenme	3
	Okul	1
	Öğretici	1
Özellik (3)	Kolaylık	1
	İletişim	1
	Yenilik	1

Tablo 6'ya göre, 1 öğretmen adayı lisans programlarında Web 2.0 ile ilgili bir şey yapılmadığını/verilmediğini ifade ederken, 15 öğrenci ise bu konuda herhangi bir fikir belirtmemiştir. Diğer tüm öğrenciler ise, Web 2.0'ın derslerde kullanıldığını söylemişlerdir. Bununla ilgili olarak öğrenciler Web 2.0'ın; "derslerde verildiğini (45), uygulamaların kullanıldığını (6), ödevlerin verildiğini (6) ve PowerPoint/Sunumlarda kullanıldığını (5)" belirtmişlerdir. Ayrıca, bu soruya anlamsız/ilgisiz (1) yanıt verenler ve hiç cevap vermeyenler (15) bulunmaktadır.

Kategori: Derste verilişi

Teknoloji dersleri içeriklerinde bolca kullanılıyor. Ödevler veriliyor. Araştırmalar veriliyor. (Ö2)
Materyal tasarım derslerinde bu araçlar tanıtılıyor ve bizden örnekler hazırlamamız isteniyor. İyi ki hocalarımız bizlere bu programları tanıttılar. Şu an çokça kullanıyorum. (Ö7)
Hocalarımız konu anlatımlarında İnternet sitelerinden, YouTube gibi uygulamalardan faydalanıyor. (Ö3)
Etkinlikler yapılıyor, Word belgeleri, sunumlar hazırlanıyor. (Ö52)

Kategori: Eğitim-öğretim

Teams, YouTube vb. yerler üzerinden ödevlendirmeler ve öğretici bilgiler veriliyor. (Ö32)
Öğrencilerin oyunlarla eğitimleri destekleniyor. (Ö20)

Kategori: Verimlilik

Eğitimi daha kolay nasıl verebilmemiz hakkında bilgi verir. (Ö43)
Yenilikler ve sistematik düzenlemeler yapılıyor. (Ö81)

Tablo 7. Web 2.0 araçlarının lisans derslerinde kullanılışı

Tema	**Kategori**	**Kod**	**f**
Kullanım Şekli (91)	Nerede? (86)	Her yer	17
		Eğitim	16
		Dersler	12
		Sınıf	7
		Okul	7
		İnternet	6
		Öğrenme	5
		Elektronik eşyalar	5
		Öğretim	3
		Sunum	3
		Uzaktan eğitim	2
		Uygulama	1
		Bilgi arama	1
		İletişim	1
	Nasıl? (5)	Etkinlik üretme	2
		Kolaylaştırma	2
		Ölçme-değerlendirme	1

Tablo 7'de görüldüğü üzere, öğretmen adayları Web 2.0 araçlarının en fazla "her yerde (17), eğitim (16) ve derslerde (12)" kullanıldığını ve Web 2.0 araçlarının etkinlik üretme (2) ve kolaylaştırma (2)" amacıyla kullanıldığını belirtmişlerdir. Ayrıca, bu soru için anlamsız/ilgisiz (1) cevap verenler ve cevap vermeyen (8) öğrenci bulunmaktadır.

Kategori: Nerede?

Her zaman, her yerde kullanılabilir. (Ö3)
Eğitimde görsel ihtiyaçlar olduğu zaman kullanılır. (Ö2)
İnternet ortamında kullanılır. (Ö40)
Derslerde, sunumlarda, toplantılarda kullanılabilir. (Ö9)

Kategori: Nasıl?

Derslerde online görüşmelerde etkinlik üretmek için kullanılır. (Ö31)
Okulda ölçme-değerlendirme amaçlı kullanılır. (Ö90)

Web 2.0'ın Gelecekte Derslere Entegrasyonu

Web 2.0'ın gelecekte derslere entegrasyonuna ait bulgular Tablo 8'de gösterilmiştir.

Tablo 8. Web 2.0'ın gelecekte derslere entegrasyonu

Tema	Kategori	Kod	f
Öneri (58)	Ders içi (74)	Etkinlik hazırlama	15
		Web 2.0 araçlarının kullanımı	9
		Ölçme-değerlendirme	9
		Eğitici oyun	6
		Sunum	5
		Öğretim materyali/Eğitici materyal	3
		Oyun tasarımı	2
		Online eğitim	1
	Ders dışı (1)	Ödev	7
		Bahçede ders	1
	Teknik (10)	Teknolojik aletler	3
		Web 2.0'ın daha çok tanıtımı	2
		Pratik yapma	2
		Web 2.0'ın uygun kullanımı	1
		Hayata dahil etme	1
		Seçmeli ders açma	1

Tablo 8'de görüldüğü üzere, öğretmen adayları Web 2.0'ın gelecekte derslere entegrasyonu ile ilgili olarak şunları vurgulamışlardır: Öğretmen adayları Web 2.0'ın derslere entegrasyonunun en çok ders içinde yapılacağını ve bunun da en çok "derslerde (16), etkinlik hazırlamada (15), Web 2.0 araçlarının kullanımında (9) ve ölçme-değerlendirmede (9)" olacağını düşünülmektedir. Öğretmen adayları Web 2.0'ın ders dışı entegrasyonunun en çok bahçede yapılabileceğini belirtmişlerdir (1). Ayrıca, öğretmen adayları okulda Web 2.0'ın entegrasyonunun daha fazla olması için "teknolojik aletlere ihtiyaç olduğu (3), Web 2.0'ın daha fazla tanıtılması gerektiği (2) ve pratik yapılması gerektiğini (2)" vurgulanmıştır. Ayrıca, bu konuda anlamsız/ilgisiz bazı cevaplar (20) ile bu soruya cevap vermeyenler de bulunmaktadır (10).

Kategori: Ders içi

Farklı eğitim kademelerinde hazırbulunuşluk düzeylerine göre etkinlikler yapılabilir. (Ö73)
Eğitici oyunlar ilgi çekici uygulamalarla öğrencilere bilgiler eğlenceli içerikler şeklinde sunulabilir. (Ö14)
Sunumlarımızda kullanılabilir. (Ö57)

Tartışma ve Sonuç

Bu çalışmada Kelime İlişkilendirme Formu ve Görüşme Formu ile toplanan öğretmen adaylarının Web 2.0 ve Web 2.0 hakkındaki düşünceleri ile ilgili bulgular ışığında şu sonuçlara ulaşılmıştır:

Çalışmada öğretmen adaylarının Web 2.0 kavramı ile ilgili toplam 400 anlamlı kavram/kelime yazdıkları tespit edilirken, öğretmen adaylarının Web 2.0 ile ilgili toplam 91 anlamlı cümle yazdıkları belirlenmiştir. Öğretmen adaylarının Web 2.0'ı en çok "teknoloji, İnternet ve Canva" ile ilişkilendirdikleri görülürken, öğretmen adaylarının Web 2.0 araçları ile ilgili en çok"eğitim, kolaylık ve teknoloji" ile ilgili cümle kurdukları görülmüştür. Ayrıca, Web 2.0 ile ilgili olarak hem kelime kısmında hem de cümle kısmında az sayıda öğrencinin anlamlı olmayan/ilgisiz cevaplar verdiği ya da cevap vermediği gözlenmiştir.

Çalışmada, pek çok öğretmen adayının Web 2.0 tanımını tam olarak bilmediği belirlenmiştir. Öğretmen adaylarının en fazla "kolaylık, teknoloji ve eğitim" ile ilgili tanım yaptıkları ve 15 öğrencinin ise bu soruya cevap vermediği gözlenmiştir. Öğretmen adaylarının toplamda 14 adet Web 2.0 aracının ismini bildikleri ve bunlardan da en fazla "Canva, Kahoot, Wordwall ve YouTube" un adını bildikleri tespit edilmiştir. Öğretmen adaylarının toplamda 13 adet Web 2.0 aracını kullanmayı bildikleri ve bunlardan da en çok "Canva, Kahoot ve Teams" i kullanmayı bildikleri belirlenmiştir. Ayrıca, öğrenciler derslerde çoğunlukla "Canva, Wordwall, Kahoot ve Teams" i kullanışlı olarak görmektedirler. Öğrenciler, Web 2.0 araçlarını daha çok "faydalı, kullanışlı ve dikkat çekici" özellikte olmaları nedeniyle dersler için yararlı bulmaktadırlar. Bazı öğrenciler ise, Web 2.0 araçlarının ismini bilme ve kullanmayı bilme konusunda anlamsız/ilgisiz yanıt vermişler ya da bu konuda herhangi bir görüş bildirmemişlerdir. Serin (2024) sınıf öğretmenlerinin matematik derslerinde Web 2.0 araçlarını orta sıklıkta kullandıklarını ve Wordwall, Quizizz ve Kahoot'un eğlenceli olduğu için en çok kullanılan araçlar olduğunu rapor etmiştir. Benzer olarak, Kayar (2019) çalışmasında lise İngilizce öğretmenlerinin derslerinde en çok "Kahoot, YouTube ve PowerPoint" kullandıklarını ve bunların öğrencileri motive ettiği, derse katılımı ve sınıf içi etkileşimi arttırdığını rapor etmiştir.

Öğrencilerin pek çoğu lisans derslerinde Web 2.0 araçlarının en çok "derslerde verildiğini" söylerken, bunu "uygulamalarda kullanılıyor, ödevler veriliyor ve PowerPoint/sunumlarda kullanılıyor" takip etmektedir. Öğretmen adayları; Web 2.0 araçlarının en fazla "her yerde, eğitimde ve derslerde" kullanıldığını düşünürken, onlar Web 2.0 araçlarının en fazla "etkinlik üretme ve kolaylaştırma" amacıyla kullanıldığı görüşüne sahiptirler. Ancak bu konuda fikir beyan etmeyen bazı öğrenciler de bulunmaktadır.

Mevcut çalışmada pek çok öğretmen adayı Web 2.0'ın gelecekte derslere entegrasyonunun yapılması gerektiğini, bunun da "etkinlik hazırlama, Web 2.0 araçlarının kullanımı ve ölçme-değerlendirmede" yapılabileceğini ifade etmişlerdir. Entegrasyon yapılması esnasında ise, daha çok "teknolojik aletlere ihtiyaç olduğu, Web 2.0'ın daha fazla tanıtılması ve pratik yapılması" gerektiği belirtilmiştir. Usta vd. (2020) öğretmen adaylarının Web 2.0 araçları hakkında bilgileri olmasına rağmen, bu araçları öğrenme ortamlarına entegre edebilme konusunda kısmen yeterli olduklarını rapor etmiştir. Bunun yanında unutulmamalıdır ki Web 2.0 araçlarının kullanımı esnasında bazı problemler yaşanabilir. Örneğin, donanım eksikliği, İnternet bağlantı sorunları, sınırlı erişim ve güncelleme problemleri, zaman problemi gibi (Akbaş & Yünkül, 2024; Kayar, 2019; Özpınar, 2020; Serin, 2024). Web 2.0 araçlarının derslere daha iyi entegre edilebilmesi için bu problemlerin giderilmesi gereklidir.

Çalışmanın yapıldığı eğitim fakültesinde Web 2.0 araçları hem çeşitli lisans programları derslerine entegre olarak kullanılmakta hem de bununla ilgili bazı seçmeli dersler verilmektedir. Ancak eğitim fakültelerinde Web 2.0 araçları uygulamalarının arttırılması gerekmektedir. Web 2.0 araçları üzerine verilecek hizmet içi kursların da daha çok yüz yüze, uygulamalı ve konuya hakim eğitmenler tarafından verilmesi önemlidir (Akbaş & Yünkül, 2024; Özpınar, 2020). Ayrıca, Web 2.0 araçları hakkında öğrencilere yönelik seminer ya da konferans sayısı da arttırılabilir.

Etik Beyan

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Çıkar çatışması beyanı: Bu çalışmada herhangi bir potansiyel çıkar çatışması bulunmamaktadır.

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Extended Abstract

Introduction

In the field of education, teachers and prospective teachers use many digital and technological tools when teaching, assigning homework, or creating classroom activities. Web 2.0 tools are among these. There are many Web 2.0 tools such as YouTube, Instagram, Canva, and Kahoot. Web 2.0 tools are applications and sites used for a variety of purposes. For example, they can be used in some applications to combine videos or convert photo memories into videos, prepare homework, organize school activities, and shop for home, work, or personal needs. As the use of Web 2.0 tools increases daily, learning how to use them is crucial. To utilize these tools, which have such a wide range of applications, both students and teachers need to be knowledgeable about them. The Web 2.0 tools selected for use in classes should be tailored to the content, objectives, and activities of the course (Timur et al., 2020).

Although there were studies in the relevant literature examining the prospective teachers' opinions about Web 2.0 and Web 2.0 tools, there was no study observed examining these with the Word Association Form. The purpose of this research was to determine the prospective teachers' opinions about Web 2.0 and Web 2.0 tools.

Method

The purpose of this study was to examine prospective teachers' opinions about Web 2.0 tools. In the study, a case study design, one of the qualitative research methods, was used. Case study is one of the qualitative research methods conducted to examine a certain situation or event (Büyüköztürk et al., 2013; Özenç, 2022). The participants consisted of 100 teacher candidates studying in the senior year at Balıkesir University Necatibey Faculty of Education in Türkiye in the 2023-2024 academic year. Data were collected byWeb 2.0 Word Association Form and Web 2.0 Written Opinion Form developed by the authors. Data were gathered by Google forms. Data were analyzed by content analysis method, and the answers given to the questions were grouped under codes and categories. Then, frequency tables were created for these. Inter-coder reliability was provided by the article's authors.

Results and Conclusions

In this study, the following conclusions were reached in the light of the findings regarding Web 2.0 and the opinions of prospective teachers about Web 2.0 collected with the Word Association Form and Interview Form:

The prospective teachers mostly associated Web 2.0 with "technology, Internet, and Canva". According to the results of the sentence section of the Web 2.0 Word Association Form, the prospective teachers mostly made sentences related to "education, convenience, and technology" regarding Web 2.0. The prospective teachers did not fully know the definition of Web 2.0.

The top codes related to the definition of Web 2.0 were: "Convenience, technology, and education". The Web 2.0 tools known mostly by the prospective teachers were "Canva, Kahoot, Wordwall, and YouTube", and the Web 2.0 tools used mostly were "Canva, Kahoot, and Teams". The prospective teachers saw "Canva, Wordwall, Kahoot, and Teams" as the most useful Web 2.0 tools in classes. The prospective teachers mentioned that Web 2.0 tools were mostly used "everywhere, in education, and lessons" and for the purposes of "producing and facilitating activities". In undergraduate programs, the prospective teachers stated that Web 2.0 was mostly given in "lectures, applications were used, homework was given, and it was used in PowerPoint/presentations". Regarding the integration of Web 2.0 into lessons, the prospective teachers mentioned that this could mostly be done at school "in lessons, activity preparation, use of Web 2.0 tools, and measurement-evaluation".The students gave also irrelevant/meaningless answers to some questions or some questions were left blank in the Web 2.0 Written Opinion Form.

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Yükseköğretimde Ölçme ve Değerlendirmenin Yeniden Düşünülmesi: Yabancı Dil Olarak İngilizce Öğrenenlerin Bilgisayar Destekli Değerlendirmeye Yönelik Algıları

Rethinking Assessment in Higher Education: EFL Students' Perceptions of Computer-Assisted Assessment

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Özet: Değerlendirme, öğrencilerin bilgi, kavrama, beceri ve yeteneklerinin yanı sıra öğrenme çıktılarını değerlendiren öğretim ve öğrenim çerçevesinin temel bir sürecidir. Son yıllarda dijital teknolojilerin hızlı gelişimi, değerlendirme dahil eğitimin neredeyse her yönünü dönüştürmüştür. Bilgisayar destekli değerlendirme (Computer-Assisted Assessment – CAA), anında geri bildirim sağlama, daha yüksek verimlilik ve öğretmenler ile öğrenciler için daha fazla esneklik sunma gibi birçok açıdan geleneksel kâğıt-kalem değerlendirme yöntemine göre üstünlük sağlamaktadır. Bu amaçla, bu çalışma lisans düzeyindeki Yabancı Dil Olarak İngilizce (EFL) öğrenenlerin bilgisayar destekli değerlendirme (CAA) hakkındaki algılarını araştırmayı ve bu algıları ile CAA ile ilgili önceki deneyimleri arasındaki ilişkiyi incelemeyi amaçlamaktadır. Araştırmanın katılımcılarını, Türkiye'de bir devlet üniversitesinde isteğe bağlı ve zorunlu hazırlık sınıflarına devam eden 102 öğrenci (63 kadın, 39 erkek) oluşturmaktadır. Veriler, öğrencilerin CAA'ya yönelik algılarını ölçen bir anket ve ara sınav puanları aracılığıyla toplanmıştır. Elde edilen bulgular, öğrencilerin CAA'nın yararlarına ilişkin genel olarak olumlu algılara sahip olduklarını göstermiştir ve bölümler arasında genel ortalama puanları açısından istatistiksel olarak anlamlı bir fark bulunmamıştır. Ancak, kadın ve erkek katılımcıların CAA'ya yönelik genel algıları arasında anlamlı bir fark tespit edilmiştir. Pearson korelasyon analizi, öğrencilerin CAA'ya yönelik algıları ile önceki deneyimleri arasında istatistiksel olarak anlamlı bir ilişki olmadığını ortaya koymuştur. Benzer şekilde, öğrencilerin CAA'ya yönelik algıları ile İngilizce dil yeterlikleri arasında da istatistiksel olarak anlamlı bir korelasyon bulunmamıştır.
Anahtar Kelimeler: Değerlendirme, bilgisayar destekli değerlendirme, Yabancı Dil Olarak İngilizce öğrenenler

Abstract: Assessment is a fundamental process in the teaching and learning framework that evaluates students' knowledge, comprehension, skills, and capacities, as well as the learning outcomes. The rapid development of digital technologies in recent years has transformed nearly every aspect of education, including assessment. Computer-assisted assessment (CAA) has many advantages over the conventional pen-and-paper assessment method, including immediate feedback, more efficiency, and more flexibility for teachers and students. Within this purpose, this study aims to investigate undergraduate EFL students' perceptions of computer-assisted assessment (CAA) and examine the relationship between their perceptions and their prior experience with CAA. The participants were 102 students (63 females and 39 males) enrolled in optional and compulsory preparatory classes at a public university in Türkiye. Data were collected via a questionnaire that measured students' perceptions of CAA and their midterm scores. The findings revealed that students generally held positive perceptions regarding the benefits of CAA, and no statistically significant difference was found in the overall mean scores across departments. However, a significant difference emerged between the general perceptions of CAA among female and male participants. Pearson correlation analysis indicated that students' perceptions of CAA were not significantly associated with their prior experience. Likewise, no statistically significant correlation was found between students' perceptions of CAA and their English language proficiency.
Key Words: Assessment, computer-assisted assessment, EFL learners

Introduction

The process of evaluating a person's knowledge, skills, comprehension, and talents is known as assessment. Students have been evaluated with pencils, pens, and paper for many years. However, because technology is constantly evolving, information and communication technology (ICT) has been incorporated into the assessment process. This has changed how evaluations are carried out, especially in educational institutions (Faniran et al., 2020). Within this framework, computer-assisted assessment (CAA) has emerged as a specialized field concerned with the effective incorporation of computers into assessment practices (Pascual-Nieto et al., 2008). Sim et al. (2004) conceptualize CAA as the use of computers to administer, grade, or analyze homework and examinations.

Computer-based assessment can be applied across a wide range of disciplines and offers opportunities for advancements in testing and evaluation. The two main types of CBA are formative and summative evaluations (Peat & Franklin, 2002). Summative evaluations help students determine how well they have learned. However, through pertinent feedback, formative assessments help students achieve their goals. Since its introduction into pedagogical contexts, CAA has been widely adopted due to its numerous advantages in the assessment process, which will be discussed in the following sections.

The Benefits of Implementing Computer-Assisted Assessment

Computers have become increasingly prevalent in assessment procedures due to several advantages, including the ability to reduce assessment load and provide novel approaches to assessment (Redecker & Johannessen, 2013). Compared with paper-based assessments, computer-assisted assessment allows the use of more sophisticated items and audiovisual materials. At the same time, the latter facilitates more sophisticated interactions between students and computers because CAA systems possess richer learner data. By recording and analyzing student interactions, one can gain a deeper understanding of the learning process and evaluate students' performance and the efficacy of the questions (Conole & Warburton, 2005).

Since CAA automatically marks students' responses to multiple questions across various activities, it provides a consistent method of marking, which is necessary for the assessment process to be valid and measurable (Conole & Warburton, 2005). This is one of the most significant aspects of using computers in assessment. As a result, it permits temporal flexibility in the evaluation process (Bull & McKenna, 2003). Additionally, it is proposed that CAA offers a more critical and integrated approach to assessment (O'Reilly, 2002). Through CAA, an assessment process can be repeated multiple times, encouraging students to use their skills for diverse versions of the same topic or situation (Bull & Danson, 2004).

Another key feature of CAA is its ability to provide immediate feedback, which motivates students to seek alternative resources and enables instructors to identify those who may need additional support (Tshibalo, 2007) and assess them according to their individual needs (Nicol, 2008). Even in classrooms with large student populations, CAA consistently and thoroughly provides feedback to each student (Tshibalo, 2007). By analyzing questions and student performance in detail, CAA can identify knowledge and learning gaps early on, which helps instructors make adjustments to the curriculum or language learning and teaching strategies (Bull & Danson, 2004). Additionally, computer-assisted tests yield more accurate results than paper tests because adaptive testing adjusts the test's difficulty based on the user's responses. This adjustment is more challenging when the user answers correctly and easier when they select an incorrect response (Ridgway et al., 2004).

The Drawbacks of Implementing Computer-Assisted Assessment

Several challenges have been identified in implementing computer-based methods/techniques for evaluating students' learning. For instance, according to Simin and Heidari (2013), integrating CAA into institutions is expensive from an administrative standpoint. Since CAA requires proficiency in technology and adherence to its guiding principles, staff members should receive training on these topics. Additionally, the computer system needs to be routinely monitored to prevent issues during critical periods, such as test periods.

From a pedagogical perspective, efficient use of computer-assisted assessment (CAA) requires sufficient training for both staff and students. Due to their practicality, multiple-choice questions are

frequently used in computer-assisted tests, but they are not ideal for assessing higher-order cognitive abilities (McKenna, 2001). Because CAA primarily uses multiple-choice questions, it seems to have limited ability to evaluate students' higher-order learning skills; instead, it tends to focus on evaluating basic knowledge (Bull & Danson, 2004).

McDaniel and Little (2019) argue that although many classroom studies show that multiple-choice questions (MCQs) do not necessarily result in lower-order or less learning, they often fail to require students to generate their own solutions, thereby limiting opportunities for analysis and synthesis, since deeper processing depends more on production than on recognition. The inability of CAA to be accessible to every student is one of the issues raised. To ensure that every student has access to exams, the necessary steps must be taken (Bull & Danson, 2004). Additionally, it is believed that, through CAA, students view learning as a data-transfer process rather than a knowledge-manipulation process (McKenna, 2001).

Previous Studies on the Implementation of Computer-Assisted Assessment

Several studies have examined the impact of Computer-Assisted Assessment (CAA) on the assessment process. CAA is a successful method of evaluating students' learning and a helpful tool for providing instant feedback (Miller, 2009; Sealey et al., 2003). Jiao and Brown (2012) investigated the influence of CAA on student performance. They found that learners appreciated receiving positive feedback on their achievements through an e-Tutor program during automatic marking. At the same time, less successful students were also motivated by the opportunity to receive immediate feedback. In line with these findings, Fletcher, Kearney, and Bartlett (2002) reported that participants' mean perception scores of the usefulness of CAA in learning assessment increased from 21% to 34% on the post-test, indicating a positive shift in students' attitudes toward CAA as a beneficial assessment tool.

Several empirical studies indicate that students have a positive attitude toward using CAA as an assessment technique (Sobremisana & Aragon, 2016). According to a study, students who completed computerized practice examinations had positive attitudes toward their practice sessions and received an average score that was half a letter higher than those who did not (Gretes & Green, 2000). A quasi-experimental study by Koedinger et al. (2010) assessed a web-based tutor that provides timely instruction and assessment. The study demonstrated the potential of online formative assessment tools to enhance student achievement, finding that increased tutoring use was associated with improved learning outcomes. In another study, Pascual-Nieto et al. (2008) investigated the effectiveness of a web-based application as an alternative tool for assessing students' learning, asking participants to express their views on its advantages and disadvantages. The results indicated that most students held positive perceptions of the program, appreciating its ability to allow learners to review course material both inside and outside the classroom, as well as its provision of immediate and more detailed feedback.

Purpose of the Study

Despite the growing popularity of computer-based tests, little is known about how students perceive online assessments in general and the various categories of online assessment systems (Özden et al., 2004). Furthermore, published research on students' opinions of online tests in higher education is limited (Ricketts & Wilks, 2002). As student assessment has become a significant concern for higher education institutions due to the increasing number of students (Tshibalo, 2007), this study examines the opinions of students enrolled in Computer-Assisted Language Learning (CALL) classes who engaged in computer-based assessments over the semester. The primary aim is to investigate whether there is a relationship between students' perceptions of Computer-Assisted Assessment (CAA) and their experience with such assessments. Within this purpose, the research questions are as follows:

RQ1: What are learners' perceptions of the implementation of CAA?

RQ2: Do learners' perceptions differ by gender?

RQ3: Do learners' perceptions differ by department?

RQ4: Is there a relationship between learners' perceptions of CAA and their prior experience with computer-assisted assessment?

RQ5: Is there a relationship between learners' perceptions of CAA and their level of English achievement?

Method

Research Model

A correlational survey model was selected as the quantitative research method in this study to examine how EFL learners perceived computer-assisted assessment and the relationships among their perceptions, prior experience with CAA, and their English achievement scores. According to Putri et al. (2025), the methodological goal of correlational research is to determine and examine, without manipulation, the relationship between two or more variables. Although it cannot establish causation, this type of research helps determine whether the variables are related. There are three possible outcomes or relationships between variables in correlational research: no correlation, negative correlation, or positive correlation. When two variables are positively correlated, they tend to move in the same direction: one increases as the other increases. On the other hand, a negative correlation implies that one variable decreases when the other increases, and vice versa. However, when there is no correlation, there is no consistent relationship between changes in one measure and changes in the other (Shreekumar, 2024).

Setting and Participants

The study was conducted at a state university in Türkiye, and the participants were undergraduate EFL learners enrolled in both optional and compulsory preparatory classes. A total of 102 students participated in the study, including 63 females and 39 males. They were drawn from different departments, were taking year-long English language courses, and had been receiving CALL lessons as part of their language learning.

The participants were selected from intact classes and divided into two groups, with each group consisting of two classes. Descriptive statistics regarding demographic information showed that Class 1 included 20 students (7 male and 13 female), Class 2 included 23 students (15 female and 8 male), Class 3 included 29 students (17 female and 12 male), and Class 4 included 30 students (18 female and 12 male).

In terms of departmental distribution, 22 participants were from the Department of Public Administration, 12 from the Department of Foreign Trade, 18 from the Department of Tourism, 28 from the Department of International Relations, and 22 from the Department of History.

Data Collection Instrument

The data were collected through a questionnaire adapted from Jamil (2012), which comprised 28 items via a 5-point Likert scale organized into two sections. The first section included 12 items designed to assess participants' general perceptions of CAA use. The second section consisted of 16 items that asked students to reflect on their experiences with CAA. Although this second part of the questionnaire was initially intended only for participants with prior experience in CAA, in this study, it was administered to all students, since they had already been taking CALL classes and practicing computer-assisted assessment. Furthermore, as the original questionnaire had been developed for Pakistani students, the items referencing Pakistan were adapted to the Turkish context. The instrument was piloted twice with students from different departments and universities to ensure content validity. The use of a standardized five-point Likert scale, consistency of responses across pilot studies, and alignment with previously validated instruments support the reliability and internal coherence of the original data collection instrument. In this study, the two field experts who validated the instrument provided feedback on its merits and weaknesses. To ensure reliability, the scale's internal consistency was calculated, yielding a high Cronbach's α (.82), indicating good reliability (George & Mallery, 2019). Moreover, negatively worded items were reverse-scored prior to the analysis.

Data Analysis

After the data were collected, participants' responses were entered into the SPSS program. Descriptive statistics were used to present demographic information about participants across several variables, including gender, mean age, length of English-language study, and department. Independent samples t-tests were conducted to determine whether there were statistically significant differences in participants' general perceptions of CAA between male and female students. Additionally, a one-way analysis of variance (ANOVA) was carried out to examine differences in perceptions across the six departments. Finally, Pearson's correlation analysis was employed to investigate the relationships among participants' perceptions of CAA, their prior experience with it, and their midterm scores. A Test of Normality was conducted for every analysis prior to deciding whether to use a parametric or non-parametric test because it is recognized that the normality assumption must be verified, as it is thought to be a requirement for statistical procedures (Ghasemi & Zahediasl, 2012).

Findings

Findings regarding the first research question

The first research question investigated EFL learners' perceptions of computer-assisted assessment. Descriptive statistics of participants' overall mean scores indicated a positive level (M = 3.02, SD = .51), suggesting that the use of computers has a generally favorable effect on learners' perceptions of computer-assisted assessment. The results revealed that the most preferred item was Item 12, which stated that "CAA should be implemented in all universities of Türkiye." The second most preferred item was Item 6 (M = 3.68, SD = 1.40), reflecting the perception that "CAA is not adequate in Türkiye," followed by Item 2 (M = 3.44, SD = 1.41), which emphasized that "Students should be trained to use computers for online tests/exams." Conversely, the lowest mean score was observed for Item 4 (M = 2.38, SD = 1.44), which suggested that "CAA is a useless technique for me because I have no knowledge about it." The second least preferred item was "CAA is an interesting examination technique" (M = 2.43, SD = 1.41), followed by Item 3 (M = 2.49, SD = 1.42), which proposed that "Computers do not need to be used in tests or exams."

Findings regarding the second research question

Researchers and educators have discovered that men and women perceive and impact the relationships between the structures that influence the behavioral intention to use computers and e-learning differently (Terzis & Economides, 2011). To this end, an independent-samples t-test was conducted to examine whether there was a statistically significant difference in the general perceptions of CAA use between female and male participants. The results are presented in Table 1 below:

Table 1. Independent samples t-test results on students' general perceptions by their gender

Group	N	X	SD	df	t	P
Female	63	2.86	.47	100	-4.257	.000
Male	39	3.27	.48			

$p<0.05$

The results revealed a statistically significant difference between male participants (M = 3.27, SD = .48) and female participants (M = 2.86, SD = .47) in their overall perceptions of CAA, $t(100) = -4.26$, $p < .001$, $d = -0.86$, $r = -0.39$, indicating a large effect size. In other words, male students reported more positive perceptions of CAA compared to female students. This finding may be related to the notion that male students tend to show greater interest in using computers in both daily life and educational settings.

Findings regarding the third research question

Another variable examined in the study was participants' departments to determine whether department affiliation had a statistically significant effect on general perceptions of CAA use. The one-way ANOVA results indicated no significant difference among departments, $F(4, 97) = 0.210$, $p = .932$. Therefore, it can be concluded that participants' departments do not have a significant impact on their perceptions of computer-assisted assessment.

Findings regarding the fourth research question

Prior computer experience and communication abilities are crucial factors in computer-based assessments (Dammas, 2016). Thus, previous computer experience has been identified as a key factor influencing examinee performance (Russell et al., 2003). Within this purpose, the fourth research question examined any relationship between learners' perceptions of CAA and their prior experiences. The results indicated no significant correlation between the two variables, Pearson's r (102)=.049, p=.628. Therefore, it suggests that participants' prior experience with CAA did not have a meaningful effect on their perceptions of computer-assisted assessment.

Findings regarding the fifth research question

A Pearson correlation analysis was conducted to investigate whether there was a relationship between participants' perceptions of CAA and their level of English achievement; the results indicated a weak, positive correlation, r(102) = .170, p = .088, but this relationship was not statistically significant. As a result, there is no significant correlation between participants' opinions of CAA and their English achievement levels. This shows that their English achievement does not explain diversity in participants' CAA impressions, and other factors are likely to have a more significant impact.

Discussion and Conclusion

Drawing on findings from the first research question, which examined EFL students' overall perceptions of computer-assisted assessment, it was revealed that they hold positive beliefs about its implementation. Similarly, Fletcher et al. (2002) reported that participants' average perception ratings showed a favourable shift in their views toward CAA, underscoring its significance as an advantageous assessment instrument. Besides, Vu (2021) examined the viability of digital representation for assessing EFL speaking skills at a university in Vietnam, and based on the findings, it was reported that attitudes toward computer-assisted assessment (CAA) were favourable among both teachers and students. They favoured the computer-assisted English assessment (CAEA) over the existing paper-and-pencil mode of testing because they felt comfortable using it.

The second research question aimed to investigate whether participants' perceptions differ by gender. Based on the findings, there is a statistically significant difference between male and female students in their general perceptions of CAA use. Several contradictory findings have been reported in the literature regarding gender differences. Öz (2014) examined pre-service English teachers' perceptions of web-based assessment, considering variables such as gender, duration and frequency of internet usage, and level of computer literacy. The results indicated that female participants scored lower than male participants across four dimensions—intention, usefulness, ease of use, and computer attitude—but reported higher levels of anxiety. However, no statistically significant differences were found between female and male participants in their overall opinions and attitudes toward web-based assessment. Akdemir and Oğuz (2008) investigated whether undergraduate students' test scores differed between computer-based and paper-and-pencil tests. They found that gender differences did not appear to influence performance in either format.

The third research question investigated whether EFL learners' perceptions differ by department and found no statistically significant difference. Kuluşaklı (2024) investigated the attitudes of undergraduate students toward online assessment in terms of their major, gender, and whether they were taking the test for the first time. The results showed that students' opinions were not significantly influenced by their major. In other words, there was no relationship between the students' attitudes regarding online assessment and their majors. However, Ricketts and Wilks (2002) investigated which factors influence students' opinions of computer-assisted assessment and found differences in learners' perceptions of CAA across subject areas, including Biology, Business, Geography, and Computing.

Based on the findings regarding the fourth research question, examining the relationship between participants' prior experience and their perceptions of CAA, it was reported that there is no significant correlation between the two variables. Eid (2005) found that students' scores on computer-based and paper-based math problem-solving assessments were comparable. Students' scores on online tests were unaffected by their computer experience or anxiety level. Nevertheless, Dammas (2016) investigated

the relationship between prior computer experience and performance in computer-based tests, and the results indicated that most students (46.938%) agreed that previous computer experience influences their performance.

The fifth research question investigated participants' perceptions of CAA and their midterm scores, and a Pearson correlation analysis indicated a weak positive relationship; however, this association was not statistically significant. This demonstrates that learners' English achievement levels do not effectively predict their perceptions of CAA, suggesting that other factors play a more substantial role in shaping their beliefs. Although the present data do not reveal a significant correlation between learners' perceptions of CAA and achievement, earlier research has demonstrated that appropriate use of CAA can promote learning outcomes. For instance, Lowry (2005) reported that providing students with access to a CAA system for self-assessment had a favourable impact on their learning performance. In a similar vein, Özden et al. (2004) found that many students believed that receiving instant feedback and scores via CAA increased their motivation and improved their academic performance.

Limitations of the study

The participants of the study consisted of 102 students enrolled in optional and compulsory preparatory classes at a state university. They were selected as a sample from among students studying in different faculties and departments. Therefore, the study's findings reflect the perceptions and experiences of a relatively small group of students regarding computer-assisted assessment (CAA).

Implications

The study's conclusions offer educators and researchers several educational and practical implications. According to participants' favorable opinions of computer-aided assessment (CAA), incorporating digital assessment technologies can improve student engagement and promote successful learning outcomes. Therefore, to ensure familiarity and reduce potential anxiety about technology-based testing, educational institutions should provide training and exposure to CAA systems, as students' experiences with them positively impact their perceptions.

The gender differences in learners' perceptions underscore the need to account for gender when designing and implementing CAA platforms. These disparities may be reduced, and more equitable learning opportunities may be promoted by offering equal access, assistance, and encouragement. Future studies could investigate other factors that influence students' perceptions of CAA. A deeper understanding of how perceptions change over time as a result of increased exposure to technology-enhanced assessments may also be possible with longitudinal studies. Additionally, research comparing various academic fields or educational settings may yield a better understanding of the efficacy and acceptance of CAA in higher education.

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