Indonesian Society for Science Educators
Journal of Science Learning
journal homepage: ejournal.upi.edu/index.php/jslearning

Effects of Web 2.0 Tools (Kahoot, Quizlet, Google Form Example) on Formative Assessment in Online Chemistry Courses

Sibel Sadi Yılmaz[1]*, Mehmed Diyaddin Yaşar[2]

[1]Department of Basic Education Classroom Education Department, Kafkas University, Turkey
[2]Mathematics and Science Education, Harran University, Ş.Urfa, Turkey

*Corresponding author: sibelsadiyilmaz@kafkas.edu.tr

ABSTRACT This study aims to examine the effects of using Kahoot, Quizlet, and Google Forms as gamification and formative assessment tools in the Chemistry II course conducted through synchronous online instruction during the COVID-19 period. The study was conducted based on a triangulation design, one of the mixed research designs in which quantitative and qualitative data collection tools and analyses are used together. This study was conducted with 32 volunteer participant students studying in the first grade of the science education department. The study used a Solutions Achievement Test (SAT) and a Chemical Kinetics Achievement Test (CKAT) as quantitative data collection tools. The results of the data analysis in the SAT and CKAT revealed a significant difference in favor of the posttest. The Student Opinion Questionnaire (SOQ), created using Conversational Interviews (CI) held with students throughout the implementation, was used as a qualitative data collection tool. The qualitative data analysis determined that the students did not participate in online classes due to the accessibility of the course video recordings, the absence of a compulsory attendance rule, and restricted access to the internet and technology. The use of Kahoot, Quizlet, and Google Forms in online classes and in students' free time outside class had positive effects, namely enjoyable and productive lessons, contribution to professional teaching skills, reinforcement of learned knowledge, and students' awareness of their learning levels through the feedback they received in a stress-free competitive environment. In addition, qualitative data were obtained to show that these applications were more effective in verbal subjects.

Keywords Gamification, Formative assessment, Online teaching, Science education

1. INTRODUCTION

Among the main goals of education is the high motivation of students to achieve meaningful learning (Prieto, Palma, Tobías & León, 2019). It is not always possible to hold students' motivation, interest, and participation in lessons together, and a negative/unfavorable atmosphere in the classroom environment and students' low grades on tests and exams negatively affect their motivation and learning products (Liu, Bridgeman & Adler, 2012). Student motivation affects students' achievement, retention of learning, and interaction in the learning environment (Şahin et al., 2017). In the 21st century, it has become necessary for many teachers to support education by integrating competitive games that will encourage learning in the classroom (Dellos, 2015). Innovations and developments in information and communication technologies support learning with new opportunities, both in schools and outside school, with new learning and teaching models (Correia & Santos, 2017). Internet access and technological development are important for meeting students' needs and providing more opportunities for students in student education in different geographical areas through distance education (Moore, Dickson-Deane & Galyen, 2011; Hartnett, George & Dron, 2011). Online learning, in which different devices with internet access are used synchronously or asynchronously (Dhawan, 2020), is regarded as a subcategory of distance education (Hartnett, George & Dron, 2011). In online distance education, students' aims and learning preferences can be very different, and especially for this reason, in order to draw their attention, meet their learning needs, and ensure motivation, it is very important to use appropriate motivating strategies in online learning platforms (Bovermann & Bastiaens, 2020), and applications aimed at tests and exams used for assessment of students (Antonaci,

Received: 14 July 2023
Revised: 01 October 2023
Published: 04 December 2023

Klemke & Specht, 2019). Although developments and innovations in technology offer teachers different opportunities in online learning environments, some teachers who are accustomed to the traditional face-to-face learning environment may have difficulty in using these new technological developments effectively (Kamble, Gauba, Desai & Golhar, 2021).

Moreover, although developing technology may increase the interaction options of individuals participating in online learning environments (Dickey, 2003), it may also prevent individuals from interacting with each other (Yıldız, 2020). Therefore, students in online learning environments need to see themselves as part of a community (Yıldız, 2020). The use of online surveys, exams, and tests is effective in eliminating the monotony of online lessons, enabling students to recall their prior knowledge, and making students aware of their learning level by giving them feedback (Prieto, Palma, Tobías & León, 2019).

Due to health measures and quarantine practices in many countries during the COVID-19 pandemic, universities and educational institutions that provided face-to-face education switched to online education practices. Providing students with good quality education in online education practices depends on the quality of the online learning environment, internet access, active and effective participation and interaction of students and teachers, the knowledge and ability to use the online learning environment correctly and effectively, and teachers' and students' knowledge about information and communication technologies (Kamble, Gauba, Desai & Golhar, 2021).

The student assessment process is important for maintaining a good quality education.

Formative assessment supports the student's "learning to learn" by providing information to the teacher and student about the student's learning level (Newton, 2007; Ceri, 2008; Vonderwell & Boboc, 2013; Ogange, Agak, Okelo & Kiprotich, 2018; Anwar, 2019; Hussein, 2019; Şad & Özer, 2019; Tsulaia & Adamia, 2020; Schildkamp, Kleij, Heitink, Kippers & Veldkamp, 2020; İlhan, Güngör & Gülseven, 2022; Kişin & İlhan, 2022;) and gives important clues about what to pay attention to in the learning process (Vonderwell & Boboc, 2013; İlhan, Güngör & Gülseven, 2022; Kişin & İlhan, 2022). Despite this, most evaluation studies have focused on summative evaluation (Irons & Elkington, 2021), and formative evaluation has received less attention than it deserves in education (Abedi, 2010; Bailey, Jensen, Nelson, Wiberg & Bell, 2017). The role of teachers is important in achieving positive results from formative assessment (Schildkamp, Kleij, Heitink, Kippers & Veldkamp, 2020). Teachers should enable students to take risks, feel safe if they make mistakes, and support students in focusing on learning rather than competing with their peers (Ceri, 2008). However, some of the teachers do not use formative assessment tools because the classes are crowded and it is challenging to give personalized feedback to each student (Hatziapostolou & Paraskakis, 2010; Hsu, Chou, & Chang, 2011) or because they do not have sufficient knowledge and experience about the nature and pedagogical strategies of formative assessment (Trauth-Nare & Buck, 2011; Schildkamp, Kleij, Heitink, Kippers & Veldkamp, 2020).

Teachers have essential duties in formative assessment activities in the classroom, yet many teachers cannot use formative assessment effectively in their lessons (Aydeniz & Pabuçcu, 2011; Black & William, 1998; Black, Harrison, Lee, Marshall & William, 2004). Formative assessment activities are performed in different ways, such as pencil-and-paper and online applications (Quizizz, Kahoot, Quizlet, etc.) (Ismail et al., 2019). In the assessment process, gamification contributes to more effective assessment by enabling students to access information sources and receive feedback as soon as they demonstrate what they have learned. Furthermore, data obtained through gamification about students' learning levels give education administrators and policymakers insight into what revisions should be made in the field of education (Menezes & De Bortolli, 2016). Many educational researchers and teachers state that the use of gamification is essential for drawing students' attention and supporting different types of learning inside or outside the classroom (Menezes & De Bortolli, 2016; Prensky, 2001) and that its use in formative assessment is important for contributing to student achievement and motivation (Zainuddin, Shujahat, Haruna & Chu, 2020; Göksün & Gürsoy, 2019; Ismail et al., 2019; Zhang & Fang, 2019). Gamification is a persuasive technology that attempts to influence individuals' behavior by activating individual motives (Blohm & Leimeister, 2013) through the use of game design elements in different environments such as health, culture, education and marketing (Antonaci, Klemke & Specht, 2019; Alsancak-Sırakaya, 2017; Deterding, Dixon, Khaled & Nacke, 2011; Huang & Soman, 2013; Seaborn & Fels, 2015). Gamification aims to create change in an observable behavior or to reinforce that behavior. To decide whether gamification is beneficial, it is important that the targeted behavior should be observable or recordable or that it is transformed into that form (Tunga & İnceoğlu, 2016). The term gamification was first discussed by Nick Pelling in 2002, began to appear in documents in 2008, and started to become popular in the second half of 2010—however, the use of gamification in education dates back to ancient times. Gamification in education is concerned with adding games to the knowledge and skill dimension intended to be acquired and facilitates student learning in the teaching process. Rather than confining the gamification to a specific pattern, it will be more beneficial to further enrich it with the experiences gained (Karataş, 2014; Sezgin, Bozkurt, Yılmaz & Van Der

Linden, 2018). In gamification, the game elements are handled in two ways: self-elements and social elements. Self-elements may include scores, achievement badges, levels, or time constraints. These elements enable students to focus on competing with themselves and recognizing their achievements. As for social elements, these are concerned with interactive competition or cooperation, such as leaderboards. These elements bring students into a community with other students, and their progress/successes are announced (Huang & Soman, 2013).

Unlike traditional classroom activities, Kahoot is a game-based learning platform used in formative assessment to determine the student's level of knowledge. Kahoot is the first student response system (SRS) to provide game experience by using game design principles based on intrinsic motivation theory (Wang & Tahir, 2020). As an interactive response system (IRS), which is called learning-centered, interactive education technology (Sun & Chen, 2016), applications such as Kahoot and Quizlet are used as gamification tools in formative assessment (Çetin & Solmaz, 2020).

Quizlet is an application created in the form of learning cards with alternatives in the form of "study" and "games" in the virtual education environment, allowing students to repeat the topic or answer questions inside or outside the classroom. Quizlet is also frequently used as a learning tool in foreign language teaching (Dizon, 2016; Montaner-Villalba, 2019; Sarıgül, 2021; Wright, 2016).

1.1 Importance of the Study

For student achievement, motivation (Prieto, Palma, Tobías & León, 2019), learning with fun, repeating what they have learned, solving plenty of questions, making assessments that will motivate students (Antonaci, Klemke & Specht, 2019), absence of anxiety about obtaining low grades from tests (Liu, Bridgeman & Adler, 2012), and active student participation in the learning environment (Dickey, 2003) are effective. Moreover, the fact that students know their learning levels by receiving feedback as soon as they demonstrate what they have learned (Menezes & De Bortolli, 2016) is also effective for student achievement. Performing formative assessment through gamification in the teaching process makes most of those mentioned above possible.

One of the indicators of a student's achievement is their ability to use the knowledge they have learned in answering the questions they encounter. Just as an athlete becomes successful with constant practice, the achievement of a student in science and mathematics courses depends on using the knowledge they have learned to answer many and various types of questions and on obtaining quick feedback on whether their answers to questions are right or wrong. Here, the importance of formative assessment emerges. However, most students do not like exams because they experience test anxiety and fear of receiving low grades. In this study, the use of Web 2.0 gamification tools in formative assessment, the quick feedback received by the students as to whether the questions they answered were right or wrong, and the fact that the exams were in the form of stress-free games had an impact on student's achievement and their development of a positive attitude towards the course. This study is also important in enabling future pre-service science teachers to gain professional experience performing effective formative assessments. We can say that this study will contribute to the studies of educational researchers who wish to investigate the effects of using Web 2.0 gamification tools in the formative assessment process.

1.2 Aim of the Study

This study examines the effect of using Google Forms and gamification tools Kahoot and Quizlet in formative assessment in the online teaching of the Chemistry II course during the COVID-19 pandemic in science teacher education. In line with the aim of the study, answers to the following research questions were sought:

1-What is the effect of using the Kahoot and Quizlet formative assessment platforms on the student achievement scores in the online Chemistry II course?

2-What are students' views on using Kahoot, Quizlet, and Google Forms during the online Chemistry II course and their extracurricular time?

1.3 Implementation Process

The study was conducted in the form of synchronous online lessons (spring semester, 2020-2021) over 11 weeks. The implementation process is given in Table 1.

2. METHOD

To provide a more comprehensive approach to the study, a triangulation design, one of the mixed methods research designs in which quantitative and qualitative data are handled together, was used (Table 1).

The quantitative part of this study was conducted according to a one-group pretest-posttest pre-experimental design. In this study, the same implementations were carried out in two subjects (solutions and chemical kinetics) to increase internal validity. Obtaining similar results from the same implementations in two subjects supports the study's internal validity. In the qualitative part of the study, to gain insight into the effects of the implementation, the conversational interviews held with the students during the implementation were examined by taking notes, and using these notes, following the implementation process, the data were obtained through Padlet and Google Forms by creating a Student Opinion Questionnaire (SOQ) consisting of 11 open-ended items.

2.1 Study Participants

This study was conducted with 32 volunteer participant students studying in the first grade of the science education department. The study sample consists of volunteer participants selected by convenience sampling. This

Table 1 Quantitative and qualitative data collection process of study

	Single-Group Pretest-Posttest Pre-experimental Design				
	Topic	**Group**	**Pretest/ Time**	**Treatment/ Time**	**Posttest/ Time**
Quantitative data collection process of study*	Solutions	A	O1 Week 1	X Weeks 1, 2, 3, 4 and 5	O1 Week 6
	Chemical Kinetics	A	O2 Week 6	X Weeks 7, 8, 9 and 10	O2 Week 11
O1: SAT, O2: CKAT, X: Use of the Kahoot and Quizlet Web 2.0 gamification tools in formative assessment in online education, CI: Conversational interviews, SOQ: Student Opinion Questionnaire *The quantitative data collection process of the study was adapted from McMillan & Schumacher (2006).					
Qualitative data collection process of study	CI held with students during the 11 weeks Student opinion questionnaire given in 11th week				

sampling method allows the researcher to access the sample easily and conduct the research. The generalisability of data obtained by this sampling method to the population is low (McMillan & Schumacher, 2006). In all, 25-30 students participated in the synchronous online classes. To analyze the changes in the scores of the same students who participated in the Solutions Achievement Test and Chemical Kinetics Achievement Test pretest and posttest, the students were asked to indicate their names and surnames or their school numbers in the tests. Accordingly, the students wrote their names and surnames or school numbers on the SAT and CKAT.

2.2 Quantitative Data Collection Tools and Analysis

The study used SAT and CKAT to determine the student's academic achievement in solutions and chemical kinetics. The data of the tests administered as a pretest and posttest were obtained through Google Forms. KR-20 reliability coefficients were calculated for the tests, and item analysis was performed. To ensure the validity of the tests, three field experts created the tests by revising the textbook questions according to the subject and acquisition.

Solutions and Chemical Kinetics Achievement Tests

In this study, three domain experts prepared the SAT, consisting of 32 multiple choice questions and CKAT consisting of 20 questions after examination of chemistry textbooks. The item difficulty index and item discrimination index of the SAT and CKAT were calculated using the data obtained from 164 students studying in the science education department. Questions with an item discrimination index of 0.3 or below were excluded from the test. Regarding the tests used in the study, the KR-20 reliability coefficient of the SAT, which consists of 28 questions, was calculated as 0.92. In comparison, the KR-20 reliability coefficient of the CKAT, consisting of 17 questions, was calculated to be 0.89. The solutions and chemical kinetics topics are given in Appendix 1.

2.3 Qualitative Data (CI, SOQ) Collection Tools and Analysis

This study was conducted by the lecturer and the researcher in recorded online classes over 11 weeks. The researcher attended the classes as a participant observer for ten weeks. In the online lessons, spontaneous and naturally developing conversational interviews (Patton, 2002) took place between the lecturer and the students about the applications. After the lesson, the researcher and the lecturer watched the recordings of the lessons and transcribed the students' opinions about the applications verbatim. Using these records, the researcher and lecturer prepared a Student Opinion Questionnaire (SOQ) with 11 open-ended questions. The SOQ data were collected in the 11th week, which was the final week of the implementation, using Padlet, defined as a virtual application of the noticeboard/wall, which is one of the means of in-class interaction and communication (Weller, 2013), and Google Forms (Google, 2022), which enables the preparation and answering of questions in different forms in the online environment, and the presentation of the results in the form of graphs and tables.

In this study, in the analysis of the qualitative data, sentences and words/synonyms of words, taken directly from the students' statements in the CI and the SOQ, were used to ensure validity by verbatim (objective) representation of the reality of the data (Creswell & Clark, 2007).

Student opinions obtained from the conversational interviews were explained with descriptive analysis, which was used to describe and interpret data obtained in qualitative research and in which opinions were quoted verbatim (Robson & McCartan, 2016).

The opinions of 27 students who filled out the student opinion questionnaire were transcribed verbatim using Microsoft Word, and coding was done separately by the lecturer and the researcher on condition of using the same sentences or words/synonyms of words used by the students. Inter-rater agreement was calculated using the formula $\Delta = C/ (C+ \partial).100$ (Δ: reliability coefficient, C: Number of agreements, ∂: Number of disagreements) (Miles & Huberman, 1994; Baltacı, 2017). The reliability coefficient was calculated as 87%. The Microsoft Word document, which was created by transcribing the opinions of 27 students, was transferred to the MAXQDA Plus 2022 program, and by utilizing the codes, the coders created the

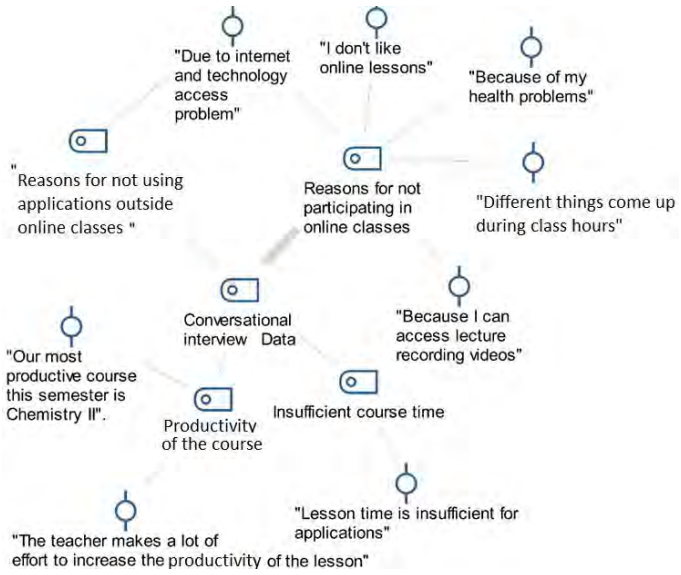


Figure 1 Descriptive analysis of CI data

themes and sub-themes using thematic coding (Robson & McCartan, 2016).

2.4 Role of the Researcher

This study was conducted by two researchers who are experts in science education. One of the researchers delivered the course, and the other took part in all lectures as an observer. The two researchers created the data collection tools, which were used after obtaining the opinions of two experts in their field and making the necessary revisions.

3. FINDINGS

3.1 Findings Obtained from the Quantitative Data

Analysis Findings of Solutions and Chemical Kinetics Achievement Tests

As shown in Table 2, 27 students participated in the pretest, and 15 participated in the posttest. The reason why a low number of students participated in the pretest and posttest was determined following an examination of the notes obtained from the CI. It can be seen that the students' mean score, which was 34.37 in the pretest, increased to 56.13 following the implementation.

Table 2 Descriptive analysis results of SAT pretest and posttest

	N	sd	Min	Max	$\bar{x}$
Pretest	27	14.18	10.71	60.69	34.37
Posttest	15	16.04	35.70	96.39	56.13

The Wilcoxon signed-rank test was used to determine whether there was a significant difference between the scores of the same students who participated in the pretest and posttest of the SAT. According to the test results (Table 3), it was observed that there was a significant ($p < .05$) difference between the students' scores before and after the implementation. In addition, it can be said that the effect size ($r = .73$) was large (0.1 = small, 0.3 = moderate, 0.5 = large).

Table 3 Wilcoxon signed-rank test results of SAT

	N	Sum of Ranks	Mean Ranks	z	p	r
Negative Ranks	1	10	10	-2.843	.004	.73
Positive Ranks	14	110	7.86			
Ties	0					

Table 4 Descriptive analysis results of CKAT pretest and posttest

	N	sd	Min	Max	$\bar{x}$
Pretest	31	16.45	11.76	76.44	39.26
Posttest	20	21.91	23.52	99.96	64.09

Table 5 Wilcoxon signed-rank test results of CKAT

	N	Sum of Ranks	Mean Ranks	z	p	r
Negative Ranks	1	1	1.00	-3.581	.000	0.80
Positive Ranks	16	152.00	9.50			
Ties	3					

When Table 4 is examined, it can be seen that the students' mean CKAT pretest score increased from 39.26 to 64.09 following the implementation.

The Wilcoxon signed-rank test was used to see if there was a significant difference between the scores of the same students who participated in the pretest and posttest of the CKAT. According to the test results, it was observed that there was a significant ($p < .05$) difference between the students' scores before and after the implementation. It can also be seen that the effect size ($r=.80$) was large (Table 5).

3.2 Findings Obtained from the Qualitative Data

Conversational Interviews (CI)

Among the factors affecting students' achievement and their attitudes towards the course can be listed students' participation/lack of participation in the lessons and the extent of their participation in the practices during the process of the course, using/not using the applications/materials, the duration of the lesson, and the performance of the teacher. The data obtained in the CI and directly quoted from the students' statements are given in Figure 1.

Findings Obtained from the Student Opinion Questionnaire (SOQ)

Of the 44 students enrolled in the online Chemistry II course, 27 expressed their opinions by filling in the SOQ. In this section, the qualitative data summarised as themes and sub-themes in Figure 2a and Figure 2b are examined in detail with themes and sub-themes.

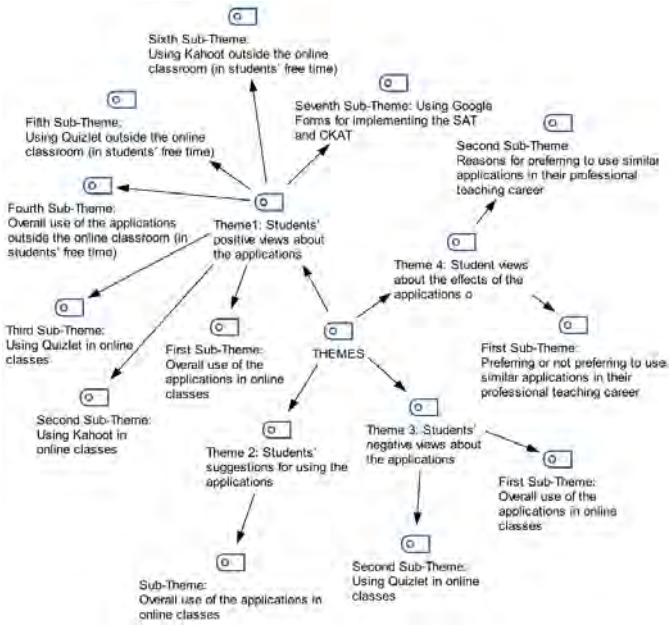


Figure 2 Themes and Sub-Themes created after examination of SOQ

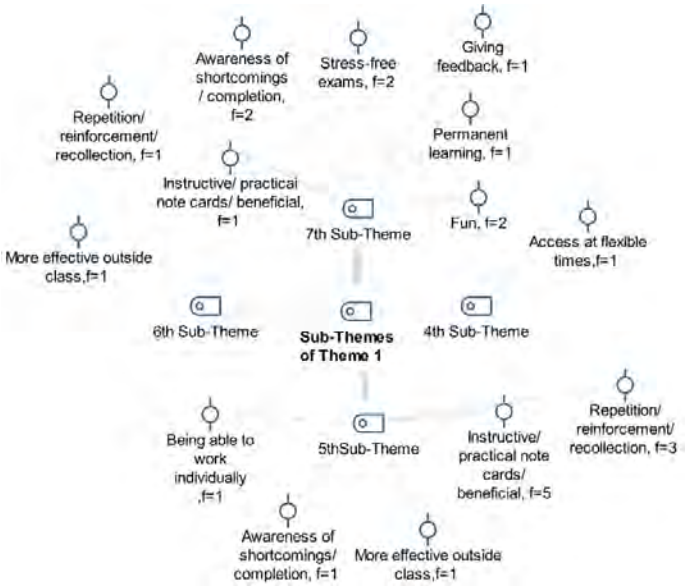


Figure 4 Findings for fourth, fifth, sixth and seventh sub-themes of Theme 1

Theme 1: Students' positive views about the applications

Regarding Theme 1, created following the SOQ examination, the students' positive views about the applications' overall use and the Kahoot and Quizlet applications in online classes were examined (Figure 3).

When Figure 3. is examined, the opinion most expressed by the pre-service teachers is the view that these practices contribute to the teaching profession skills ("we intend to use these practices that contribute to our professional skills in our future professional life", ∑f=21). In addition, the other most repeated opinions: fun code (∑f= 29, "apps were great fun"), high-quality questions (∑f=18, "questions were great and good quality"), effective/efficient lessons (∑f=16, "classes were very productive"), stress-free exam (∑f= 15, "we solved the questions in the exams without getting stressed"), recognizing the deficiencies (∑f= 8, "we noticed our learning level, our deficiencies").

Figure 3 Findings for first, second and third sub-themes of Theme 1

When we examine Figure 4, we can see that the students mostly reported positive opinions (∑f=11) about the use of Quizlet outside class (5th Sub-Theme) and that in second place, they reported positive opinions (∑f=10) about using Google Forms outside class (7 th Sub-Theme). Students' opinions were determined that the cards in the Quizlet application were instructive and contributed to the reinforcement of knowledge by enabling repetition of the information learned. Among the positive opinions they expressed about taking exams with the Google Forms application, the opinion about stress-free exams draws attention.

4th Sub-Theme of Theme 1: Overall use of the applications outside the online classroom

5th Sub-Theme of Theme 1: Using Quizlet outside the online classroom

6th Sub-Theme of Theme 1: Using Kahoot outside the online classroom

7th Sub-Theme of Theme 1: Using Google Forms for implementing the SAT and CKAT

Theme 2: Students' suggestions for using the applications

Examination of Figure 5 shows that students stated that it would be better to use applications like Kahoot and Quizlet for verbal subjects (f=10). It can also be seen that there were suggestions to the effect that teachers should

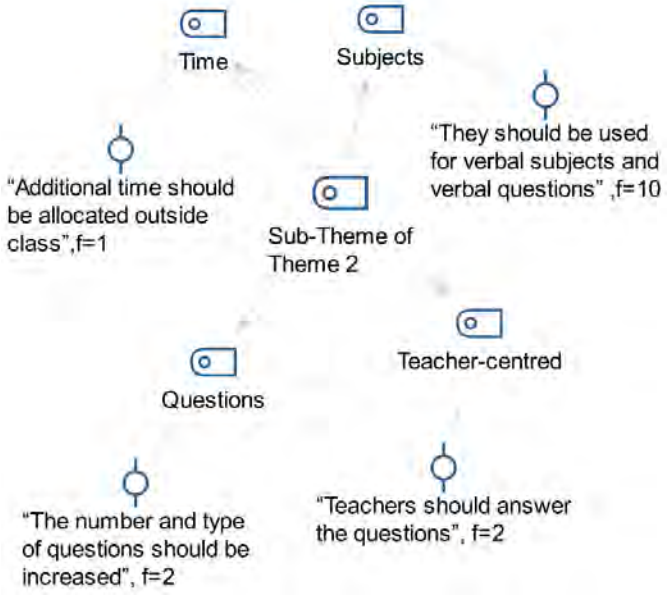


Figure 5 Findings regarding sub-theme of Theme 2

answer the questions in class (f=2) and that the number and type of questions should be increased (f=2).

Theme 3: Students' negative views about the applications

In Figure 6, students' negative views about the problems and practices encountered during the application are included. The main ones are students' internet and technology access problems (f=10) and some students' dissatisfaction with technology-oriented learning environments (∑f=6).

In Figure 6, students' negative views about the problems and practices encountered during the application

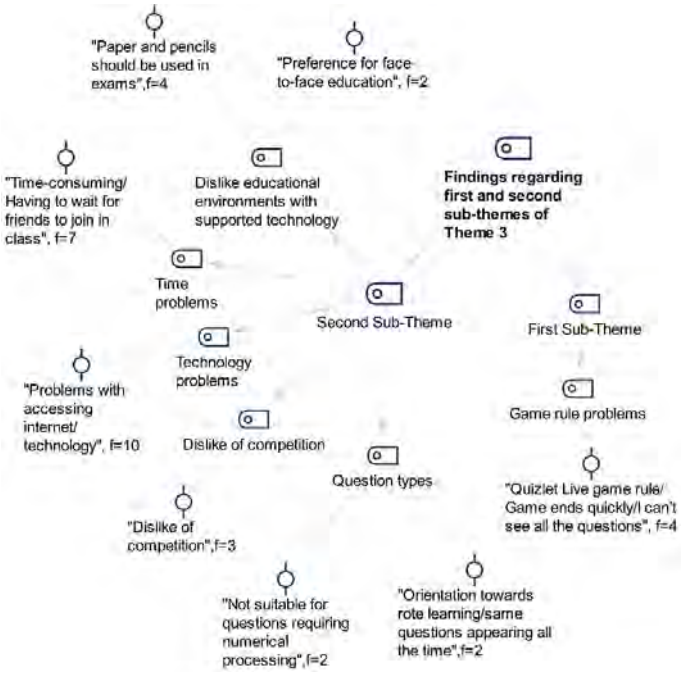


Figure 6 Findings regarding first and second sub-themes of Theme 3

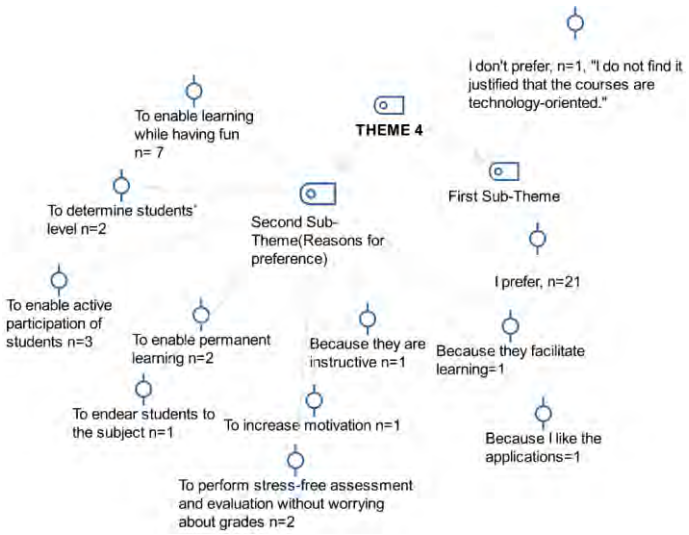


Figure 7 Findings regarding first and second sub-themes of Theme 4

are included. The main ones are students' internet and technology access problems (f=10) and some students' dissatisfaction with technology-oriented learning environments (∑f=6).

Theme 4: Students' views on the effects of the applications on their professional teaching skills

Theme 4, created due to the examination of the SOQ, was examined under two sub-themes. The first sub-theme concerns whether students prefer to use similar applications in their professional teaching careers. Of the 22 students who expressed their opinions on this sub-theme, 21 stated that they preferred to use similar applications in their professional teaching careers. In contrast, one student stated they would not prefer to use similar applications because they did not find it right that technology should dominate the learning environment. Within the scope of the second sub-theme, in which the reasons why students would prefer to use similar applications in their professional teaching careers were examined, students stated that they would prefer these applications because they enable learning with fun, they ensure students' active participation in the learning environment, they enable permanent learning, and they allow students to have an idea about their level (Figure 7). Considering the qualitative findings, it can be seen that students' positive opinions about the use of these applications in online classes and outside classes (Figure 3) and the reasons for preferring these applications in their professional teaching careers are similar (Figure 7).

4. DISCUSSION

Students' low scores in tests or exams are among the factors causing decreased motivation and achievement in the subject (Liu, Bridgeman & Adler, 2012). The fact that the learning environment motivates the student (Prieto, Palma, Tobías & León, 2019), and that there are good quality formative assessments that give students feedback

about their levels are among the factors that positively affect student achievement (Sadler, 1998). This study also determined that the use of gamification tools, namely Kahoot and Quizlet, and the use of Google Forms in formative assessment in the online learning process positively affected student achievement (Table 3 and Table 5). In this study, it can be seen that the qualitative data supports and accounts for the quantitative results of the study. Thus, The students' opinions obtained from the SOQ are that the implementations made the students aware of their shortcomings, the lessons were enjoyably spent, a stress-free exam and competitive environment were created, the implementations facilitated the reinforcement and recollection of the learned information, the student felt the need to come to the lesson prepared, and active participation in the lesson and in-class interaction increased (Figure 2 and 3). These data explain the reason for the increase in student achievement. When the literature is examined, similar results can be seen. Arif, Zubir, Mohammad & Yunus (2019) stated that university students expressed positive opinions about using Kahoot as a formative assessment tool in foreign language teaching. In the study by Yılmaz & Yılmaz (2019), preservice teachers expressed that using Kahoot as a gamification and formative assessment tool was fun, motivating for the subject, and useful for reinforcing the learned information. Ismail & Mohammad (2017) stated that using Kahoot in formative assessment in medical education assisted the teacher with its instant feedback feature while giving the students an idea about what they had learned and needed to learn. It was an application that motivated students to study. Kalleny (2020) stated that using Kahoot as a formative assessment tool in the histology and cell biology laboratory during the COVID-19 pandemic positively affected students' achievement, interest, and motivation for the course. Yilmaz (2023) stated that using the Kahoot application in the face-to-face General Chemistry course contributed positively to the student's achievement. Nadeem & Falig (2020) reported that using Kahoot in foreign language teaching with adults contributed to developing students' self-regulation skills by improving effective feedback, the classroom environment, and students' metacognitive characteristics. In their study, Bratel, Kostiuk, Bratel & Okhrimenko (2021) stated that foreign language teachers in Ukraine mostly used Kahoot, Google Forms, and Quizlet in online education during the COVID-19 pandemic. Besides the studies that reported positive results on the use of Kahoot, Kapsalis, Galani & Tzafea (2020) stated that no statistically significant difference was determined between the control group using paper and pencils and the experimental group using the Kahoot application for formative assessment in foreign language teaching with adults. Again, in the literature review, studies show that using Quizlet in formative assessment is preferred in foreign language education. The reason for this may be the cards in the Quizlet application contain information in the form of definitions/terms. Platzer (2020) stated that Quizlet was effective for learning vocabulary in foreign language learning. In their study conducted with adults, Göksün & Gürsoy (2019) stated that in comparing the two experimental groups, Kahoot and Quiziz applications were used in formative evaluation. In the control group, in which a traditional method was used, there was a difference in favour of the experimental group in which Kahoot was used. In contrast, there was no significant difference regarding academic achievement between the experimental group in which Quiziz was used and the control group. Setiawan & Wiedarti (2020) reported that using Quizlet in vocabulary teaching with tenth-grade students in a foreign language class significantly affected students' motivation. In the study conducted by Çetin & Solmaz (2020), social studies teacher candidates stated that Kahoot was effective in drawing attention, remembering what was learned, and enabling performance evaluation, while Quizlet was effective in drawing attention, presenting information, and remembering information. Prieto, Palma, Tobías & León, (2019) analyzed 12-16-year-old secondary school students' opinions about using Kahoot in mathematics and science classes. He stated that most students reported that the use of Kahoot in the lessons positively contributed positively to their cognitive and affective domains. Among these, they stated that Kahoot contributed to self-evaluation, that learning was effective, and that learning was fun. This study conducted with preservice science teachers shows that using applications like Kahoot and Quizlet in the learning process contributed to their professional teaching skills and that they would choose similar applications in their future teaching careers (Figure 3).

5. CONCLUSION

Adapting formative assessment techniques in face-to-face classes to online teaching is difficult (Vonderwell & Boboc, 2013). Developing information and communication technologies enables many interactive and innovative learning and e-assessment activities (Elmahdi, Al-Hattami & Fawzi; 2018; Permana & Permatawati, 2020). Google form and gamification-based tools such as Kahoot and Quizlet, which are e-formative assessment tools used in the learning-teaching process, can provide quick feedback to teachers and students about the student's learning level with an interactive learning environment (Douell, 2020; Alharbi, Alhebshi & Meccawy, 2021). The results obtained from these tools It can help identify and meet student needs by providing information about how the learning process is progressing (Beatty & Gerace, 2009; Fuller & Dawson, 2017; Elmahdi, Al-Hattami & Fawzi; 2018; Permana & Permatawati, 2020; Çekiç & Bakla, 2021). These tools contribute to students' learning with fun, motivation to learn, and permanent learning (Ismail &

Mohammad, 2017; Anamalai & Yatim, 2019; İsmail et al., 2019; Şad & Özer, 2019; Mdlalose, Ramaila & Ramnarain, 2022). However, teachers have a great responsibility to effectively integrate developing information and communication technologies into lessons and formative assessment (Elliott, 2012; Fuller & Dawson, 2017; Şad & Özer, 2019; Sheard, Chambers & Elliott, 2012; Remmi & Hashim, 2021; Mdlalose, Ramaila & Ramnarain, 2022). Of course, many factors enable teachers to integrate information and communication technologies into lessons effectively: age, interest in using technology, access to equipment and technology, and the teacher's education (Zehra & Bilwani, 2016; Abel, Tondeur & Sang, 2022). When using gamification-based formative assessment tools, teachers should remember that some students dislike competition (Obery, Lux, Cornish, Grimberg & Hartshorn, 2021). E-formative assessment tools can provide a learning environment where students have high self-confidence by helping to determine students' performances in a constructive and stress-free environment (Mayland, 2019; Jalani & Hashim, 2020).

Literature review and results obtained from this study: It can be said that e-formative assessment tools positively affect students in cognitive and affective areas in the teaching-learning process. In this study, we tried to comprehensively discuss e-formative assessment practices in online chemistry courses with prospective science teachers. In line with the data obtained from the study, teachers have great responsibilities in meeting the needs of students who do not like competition in the formative evaluation process and in creating a stress-free environment where students feel safe. However, when the literature is examined, it is seen that there are few studies on this subject. As a result, in the 21st century, where information and communication technologies are constantly renewed, teacher candidates in different branches need a good education to have sufficient knowledge and experience to use e-formative assessment tools effectively in their professional lives. The results obtained from studies in this field may provide important clues on how to carry out a better teaching process for teacher candidates.

REFERENCES

Abedi, J. (2010). Research and recommendations for formative assessment with English language learners. *Handbook of formative assessment*, 181-197.

Abel, V. R., Tondeur, J., & Sang, G. (2022). Teacher perceptions about ICT integration into classroom instruction. *Education Sciences*, *12*(9), 609. https://doi.org/10.3390/educsci12090609

Alharbi, A. S., Alhebshi, A. A., & Meccawy, Z. (2021). EFL students' and teachers' perceptions of Google forms as a digital formative assessment tool in Saudi secondary schools. *Arab World English Journal (AWEJ) Special Issue on CALL*, (7). https://dx.doi.org/10.24093/awej/call7.10

Alsancak-Sırakaya, D.(2017). Oyunlaştırılmış tersyüz sınıf modeline yönelik öğrenci görüşleri [Student views on the gamified flipped classroom model]. *Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi*, *36*(1), 114-132. https://dergipark.org.tr/en/pub/omuefd/issue/30333/327393

Anamalai, T. R., & Yatim, M. M. (2019). A comparative study of formative assessment tools. *Journal of Information System and Technology Management*, *4*(14), 61-71. https://doi.org/10.35631/jistm.414006

Antonaci, A., Klemke, R., & Specht, M. (2019). The effects of gamification in online learning environments: A systematic literature review. *Informatics* ,*6(3),*32. https://doi.org/10.3390/informatics6030032

Anwar, S. (2019). Formative assessment tool for active learning. *European Journal of Biomedical and Pharmaceutical sciences*, 6(1), 480-485.

Arif, F. K. M., Zubir, N. Z., Mohamad, M., & Yunus, M. M. (2019). Benefits and challenges of using game-based formative assessment among undergraduate students. *Humanities & Social Sciences Reviews*, *7*(4), 203-213. https://doi.org/10.18510/hssr.2019.7426

Aydeniz, M., & Pabuccu, A. (2011). Understanding the impact of formative assessment strategies on first year university students' conceptual understanding of chemical concepts. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi, 5(2),* 18-41.

Bailey, E. G., Jensen, J., Nelson, J., Wiberg, H. K., & Bell, J. D. (2017). Weekly formative exams and creative grading enhance student learning in an introductory biology course. *CBE—Life Sciences Education*, 16(1), ar2. https://doi.org/10.1187/cbe.16-02-0104

Baltacı, A. (2017). Nitel veri analizinde Miles-Huberman modeli [Miles-Huberman model in qualitative data analysis]. *Ahi Evran Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 3(1), 1-14.

Beatty, I. D., & Gerace, W. J. (2009). Technology-enhanced formative assessment: A research-based pedagogy for teaching science with classroom response technology. *Journal of science education and technology*, *18*, 146-162. https://doi.org/10.1007/s10956-008-9140-4

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in education: principles, policy & practice, 5(1)*, 7-74. https://doi.org/10.1080/0969595980050102

Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2004). Working inside the black box: Assessment for learning in the classroom. *Phi delta kappan*, *86(1),* 8-21. https://doi.org/10.1177/003172170408600105

Blohm, I., & Leimeister, J. M. (2013). Design of IT-Based Enhancing Services for Motivational Support and Behavioral Change. *Business & Information Systems Engineering, 5,* 275-278. http://dx.doi.org/10.1007/s12599-013-0273-5

Bovermann, K., & Bastiaens, T. J. (2020). Towards a motivational design? Connecting gamification user types and online learning activities. *Research and Practice in Technology Enhanced Learning*, *15*(1), 1-18. https://doi.org/10.1186/s41039-019-0121-4

Bratel, O., Kostiuk, M., Bratel, S., & Okhrimenko, I. (2021). Student-centered online assesment in foreign language classes. *Linguistics and Culture Review*, *5*(S3), 926-941. https://doi.org/10.21744/lingcure.v5nS3.1668

Çekiç, A., & Bakla, A. (2021). A review of digital formative assessment tools: Features and future directions. *International Online Journal of Education and Teaching (IOJET)*, 8(3). 1459-1485.

Ceri, O. (2008), "21st century learning: research, innovation and policy, directions from recent OECD

Çetin, E., & Solmaz, E. (2020). Gamifying the 9 Events of Instruction with Different Interactive Response Systems: The Views of Social Sciences Teacher Candidates. *Malaysian Online Journal of Educational Technology*, *8*(2), 1-15. http://dx.doi.org/10.17220/mojet.2020.02.001

Correia, M., & Santos, R. (2017, November). Game-based learning: The use of Kahoot in teacher education. In *2017 International Symposium on Computers in Education (SIIE)* (pp. 1-4). IEEE.

Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research*. Sage publications.

Dellos, R. (2015). Kahoot! A digital game resource for learning. *International Journal of Instructional technology and distance learning, 12*(4), 49-52.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining" gamification". In *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments* (pp. 9-15).

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of educational technology systems*, *49*(1), 5-22. https://doi.org/10.1177/0047239520934018

Dickey, M. D. (2003). 3D virtual worlds: an emerging technology for traditional and distance learning. *Proceedings of Ohio Learning Network. OH: Columbus.*

Dizon, G. (2016). Quizlet in the EFL classroom: Enhancing academic vocabulary acquisition of Japanese university students. *Teaching English with Technology*, *16*(2), 40-56.

Douell, M. (2020). *Integrating Google Forms as a Means of Formative Assessment in the Elementary Math Classroom*. HonorsTheses.1467.https://egrove.olemiss.edu/hon_thesis/1467

Elliott, J. (2012). *An introduction to sustainable development*. Routledge.

Elmahdi, I., Al-Hattami, A., & Fawzi, H. (2018). Using Technology for Formative Assessment to Improve Students' Learning. *Turkish Online Journal of Educational Technology-TOJET*, *17*(2), 182-188.

Fuller, J. S., & Dawson, K. M. (2017). Student response systems for formative assessment: Literature-based strategies and findings from a middle school implementation. *Contemporary Educational Technology*, *8*(4), 370-389. http://dx.doi.org/10.30935/cedtech/6206

Göksün, D. O., & Gürsoy, G. (2019). Comparing success and engagement in gamified learning experiences via Kahoot and Quizizz. *Computers & Education*, *135,* 15–29. https://doi.org/10.1016/j.compedu.2019.02.015.

Google (2022). Online: http:// https://www.google.com/forms/about/ [accessed 06 May 2022].

Hartnett, M., George, A. S., & Dron, J. (2011). Examining motivation in online distance learning environments: Complex, multifaceted and situation-dependent. *The International Review of Research in Open and Distributed Learning*, *12*(6), 20-38. https://doi.org/10.19173/irrodl.v12i6.1030

Hatziapostolou, T., & Paraskakis, I. (2010). Enhancing the impact of formative feedback on student learning through an online feedback system. *Electronic Journal of E-learning*, *8*(2), 111-122.

Hsu, J. L., Chou, H. W., & Chang, H. H. (2011). EduMiner: Using text mining for automatic formative assessment. *Expert Systems with Applications*, *38*(4), 3431-3439.

Huang, W.H.-Y. & Soman, D. (2013) *Gamification of Education. Research Report Series: Behavioural Economics in Action*. Rotman School of Management, University of Toronto.

Hussein, H. J. (2019). The impact of using Socrative based formative assessment to enhance student achievement in a nutrition course: A digital forward assessment. *Journal for Researching Education Practice and Theory (JREPT),* 2(1),34-56

İlhan, N., Güngör, H., & Gülseven, E. (2022). Scale of attitudes towards online formative assessment: Teacher' attitudes during COVID-19 Pandemic. *International Journal of Educational Methodology,* 8(2), 241-257. https://doi.org/10.12973/ijem.8.2.241

Irons, A., & Elkington, S. (2021). *Enhancing learning through formative assessment and feedback*. Routledge.

Ismail MA-A, Mohammad JA-M (2017). Kahoot: a promising tool for formative assessment in medical education. *Education in Medicine Journal.*, 9(2), 19–26. https://doi.org/10.21315/eimj2017.9.2.2

Ismail, M. A. A., Ahmad, A., Mohammad, J. A. M., Fakri, N. M. R. M., Nor, M. Z. M., & Pa, M. N. M. (2019). Using kahoot! As a formative assessment tool in medical education: A phenomenological study. *BMC Medical Education*, *19(1),* 230. https://doi.org/10.1186/s12909-019-1658-z

Jalani, N. A. B. M., & Hashim, H. B. (2020). Quizziz: ESL students' perceptions in rural school. *International Journal of Scientific and Research Publications*, *10*, 23-27. http://dx.doi.org/10.29322/IJSRP.10.03.2020.p9904

Kalleny, N. K. (2020). Advantages of Kahoot! Game-based formative assessments along with methods of its use and application during the COVID-19 pandemic in various live learning sessions. *Journal of Microscopy and Ultrastructure*, *8*(4), 175. doi: 10.4103/JMAU.JMAU_61_20

Kamble, A., Gauba, R., Desai, S., & Golhar, D. (2021). Learners' perception of the transition to instructor-led online learning environments: Facilitators and barriers during the COVID-19 pandemic. *International Review of Research in Open and Distributed Learning, 22(1),* 199-215.

Kapsalis, G. D., Galani, A., & Tzafea, O. (2020). Kahoot! As a Formative Assessment Tool in Foreign Language Learning: A Case Study in Greek as an L2. *Theory and Practice in Language Studies*, *10*(11), 1343-1350. http://dx.doi.org/10.17507/tpls.1011.01

Karataş, E. (2014). Eğitimde Oyunlaştirma: Araştirma Eğilimleri [Gamification in Education: Research Trends]. *Ahi Evran Üniversitesi Kirşehir Eğitim Fakültesi Dergisi,* 15(2), 315-333.

Kişin, M. & İlhan, N. (2022). Öğretmen ve öğretmen adaylarının fen derslerindeki değerlendirme hakkındaki inanç ve uygulama düzeyleri [Beliefs and practice levels of teachers and pre-service teachers about assessment in science courses]. *İnönü Üniversitesi Eğitim Fakültesi Dergisi*, 23(1), 20-43. https://doi.org/10.17679/inuefd.1074979

Liu, O. L., Bridgeman, B., & Adler, R. M. (2012). Measuring learning outcomes in higher education: Motivation matters. *Educational Researcher*, *41*(9), 352-362. http://dx.doi.org/10.3102/0013189X12459679

Mayland, M. P. (2019, November). Formative assessment: a 20th Century Relic or a 21st Century Solution?. In *Conference Proceedings. Innovation in Language Learning 2019*.

McMillan, J. H., & Schumacher, S. (2006). *Research in Education: Evidence-Based Inquiry, MyEducationLab Series*. Pearson.

Mdlalose, N., Ramaila, S., & Ramnarain, U. (2022). Using Kahoot! as a Formative Assessment Tool in Science Teacher Education. *International Journal of Higher Education*, *11*(2), 43-51. https://doi.org/10.5430/ijhe.v11n2p43

Menezes, C. C. N., & De Bortolli, R. (2016). Potential of Gamification as Assessment Tool. *Creative Education, 7*, 561-566.). http://dx.doi.org/10.4236/ce.2016.74058

Miles, M, B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded Sourcebook. (2nd e*d). Thousand Oaks, CA: Sage

Montaner-Villalba, S. (2019). The use of Quizlet to enhance vocabulary in the English language classroom. *CALL and complexity–short papers from EUROCALL*, 304-309.

Moore, J. L., Dickson-Deane, C., & Galyen, K. (2011). e-Learning, online learning, and distance learning environments: Are they the same?. *The Internet and higher education*, 14(2), 129-135. https://doi.org/10.1016/j.iheduc.2010.10.001

Nadeem, N. H., & Al Falig, H. A. (2020). Kahoot! quizzes: a formative assessment tool to promote students' self-regulated learning skills. *Journal of Applied Linguistics and Language Research*, *7*(4), 1-20.

Newton, P. E. (2007). Clarifying the purposes of educational assessment. *Assessment in education*, 14(2), 149-170. https://doi.org/10.1080/09695940701478321

Obery, A., Lux, N., Cornish, J., Grimberg, B. I., & Hartshorn, A. (2021). Competitive Games as Formative Assessment in Informal Science Learning: Improvement or Hindrance?. *TechTrends*, *65*(4), 454-463, https://doi.org/10.1007/s11528-021-00619-3

Ogange, B. O., Agak, J. O., Okelo, K. O., & Kiprotich, P. (2018). Student perceptions of the effectiveness of formative assessment in an online learning environment. *Open Praxis*, 10(1), 29-39. https://doi.org/10.5944/openpraxis.10.1.705

Patton, M. Q. (2002). Two decades of developments in qualitative inquiry: A personal, experiential perspective. *Qualitative social work*, *1*(3), 261-283.

Permana, P., & Permatawati, I. (2020, March). Using Quizizz as a formative assessment tool in German classrooms. In *3rd International Conference on Language, Literature, Culture, and Education (ICOLLITE 2019)* (pp. 155-159). Atlantis Press.

Platzer, H. (2020). The Role of Quizlet in Vocabulary Acquisition. *Electronic Journal of Foreign Language Teaching*, 17(2), 421-438

Prensky, M. (2001). Digital Natives, Digital Immigrants Part 1. *On the Horizon, 9*, 1-6. http://dx.doi.org/10.1108/10748120110424816

Prieto, M. C., Palma, L. O., Tobías, P. J. B., & León, F. J. M. (2019). Student assessment of the use of Kahoot in the learning process of science and mathematics. *Education Sciences*, *9*(1), 55. https://doi.org/10.3390/educsci9010055

Remmi, F., & Hashim, H. (2021). Primary school teachers' usage and perception of online formative assessment tools in language assessment. *International Journal of Academic Research in Progressive Education and Development*, *10*(1), 290-303. https://doi.org/10.6007/IJARPED/v10-i1/8846

Robson, C., & McCartan, K. (2016). *Real world research: a resource for users of social research methods in applied settings*. Wiley.

Şad, S. N. & Özer, N. (2019). Using Kahoot! as a gamified formative assessment tool: A case study, *International Journal of Academic Research in Education*, 5(1), 43-57. https://doi.org/10.17985/ijare.645584

Sadler, D. R. (1998). Formative assessment: Revisiting the territory. *Assessment in education: principles, policy & practice*, *5*(1), 77-84, https://doi.org/10.1080/0969595980050104

Şahin, Y. L., Karadağ, N., Bozkurt, A., Doğan, E., Kılınç, H., Uğur, S., ... & Güler, C. (2017). Uzaktan eğitimde oyunlaştırma kullanımı: oyunlaştırılmış web tabanlı bir alıştırma uygulaması [Using gamification in distance education: a gamified web-based exercise application]. *Turkish Online Journal of Qualitative Inquiry (TOJQI)*, *8*(4), 372-395, https://doi.org/10.17569/tojqi.329742

Sarıgül, K. (2021). Yabancı Dil Olarak Türkçe Öğretiminde Çevrim İçi Süreç Değerlendirme Araçları [Online Process Evaluation Tools in Teaching Turkish as a Foreign Language]. *Karamanoğlu Mehmetbey Üniversitesi Edebiyat Fakültesi Dergisi,* 4 (2021 Yunus Emre ve Türkçe Yılı Yabancı Dil Olarak Türkçe Öğretimi Özel Sayısı), 56-80.

Schildkamp, K., van der Kleij, F. M., Heitink, M. C., Kippers, W. B., & Veldkamp, B. P. (2020). Formative assessment: A systematic review of critical teacher prerequisites for classroom practice. *International Journal of Educational Research*, *103*, 101602. https://doi.org/10.1016/j.ijer.2020.101602

Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A survey. *International Journal of human-computer studies*, *74*, 14-31, https://doi.org/10.1016/j.ijhcs.2014.09.006

Setiawan, M. R., & Wiedarti, P. (2020). The effectiveness of Quizlet application towards students' motivation in learning vocabulary. *Studies in English Language and Education*, *7*(1), 83-95, https://doi.org/10.24815/siele.v7i1.15359

Sezgin, S., Bozkurt, A., Yılmaz, E. A., & Van der Linden, N. (2018). Oyunlaştırma, eğitim ve kuramsal yaklaşımlar: Öğrenme süreçlerinde motivasyon, adanmışlık ve sürdürebilirlik [Gamification, education and theoretical approaches: Motivation, commitment and sustainability in learning processes]. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, (45), 169-189. https://doi.org/10.21764/maeuefd.339909

Sheard, M. K., Chambers, B., & Elliott, L. (2012). *Effects of technology-enhanced formative assessment on achievement in primary grammar*. Report. Institute for Effective Education , York.

Sun, J. C. Y., & Chen, A. Y. Z. (2016). Effects of integrating dynamic concept maps with Interactive Response System on elementary school students' motivation and learning outcome: The case of anti-phishing education. *Computers & Education*, 102, 117-127. https://doi.org/10.1016/j.compedu.2016.08.002

Trauth-Nare, A., & Buck, G. (2011). Using reflective practice to incorporate formative assessment in a middle school science classroom: A participatory action research study. *Educational Action Research*, *19*(3), 379-398.

Tsulaia, N., & Adamia, Z. (2020). Formative assessment tools for higher education learning environment. *WEST–EAST*, 3 (1) 86-93 .

Tunga, Y., & İnceoğlu, M. M. (2016, Nisan). Oyunlaştırma tasarımı. *3rd. International Conference on New Trends in Education (3. Uluslararası Eğitimde Yeni Yönelimler Konferans), (s.*267-279).

Vonderwell, S. K., & Boboc, M. (2013). Promoting formative assessment in online teaching and learning. *TechTrends*, *57*, 22-27. https://doi.org/10.1007/s11528-013-0673-x

Wang, A. I., & Tahir, R. (2020). The effect of using Kahoot! for learning–A literature review. *Computers & education,* 149, 103818, https://doi.org/10.1016/j.compedu.2020.103818

Weller, A. (2013). The use of Web 2.0 technology for pre-service teacher learning in science education. *Research in Teacher Education,* 3(2), 40-46. https://doi.org/10.15123/uel.85w24

Wright, B. A. (2016). Transforming vocabulary learning with Quizlet. *Transformation in language education. Tokyo: JALT*, 436-440.

Yıldız, E. (2020). Çevrimiçi öğrenme ortamlarında uzaktan eğitim öğrencilerinin topluluk hissine etki eden faktörlerin incelenmesi. Egitimde Nitel Araştırmalar Dergisi – *Journal of Qualitative Research in Education,* 8(1), 180-205. https://doi.org/10.14689/issn.2148-2624.1.8c.1s

Yılmaz, R., & Yilmaz, F. G. K. (2019). Bir oyunlaştırma ve biçimlendirici değerlendirme aracı olarak kahoot kullanımına yönelik öğretmen adaylarının görüşlerinin incelenmesi [Examining the views of pre-service teachers on the use of kahoot as a gamification and formative assessment tool]. *Presented at II. Uluslararası Eğitimde ve Kültürde Akademik Çalışmalar Sempozyumu'nda (II. International Symposium of Academic Studies on Education and Culture) I-SASEC, (12-14 September) (331-337 ss). Denizli/Turkey*

Yilmaz, S. S. (2023). Web 2.0 Destekli Biçimlendirici Değerlendirme Araçlarının (Kahoot Örneği) Fen Bilimleri ve Kimya Derslerinde Farklı Kademe ve Öğretim Şekillerinde Kullanımı [The Use of Web 2.0 Supported Formative Assessment Tools (Kahoot Example) in Science and Chemistry Courses at Different Levels and Teaching Styles]. *Eğitim Bilim ve Araştırma Dergisi*, *4*(2), 568-585.

Zainuddin, Z., Shujahat, M., Haruna, H., & Chu, S. K. W. (2020). The role of gamified e-quizzes on student learning and engagement: An interactive gamification solution for a formative assessment system. *Computers & education*, 145, 103729, https://doi.org/10.1016/j.compedu.2019.103729

Zehra, R., & Bilwani, A. (2016). Perceptions of Teachers Regarding Technology Integration in Classrooms: A Comparative Analysis of Elite and Mediocre Schools. *Journal of Education and Educational Development, 3*(1), 1. https://doi.org/10.22555/joeed.v3i1.709

Zhang, H., & Fang, L. (2019). Project-based learning for statistical literacy: A gamification approach. In *Digital Turn in Schools—Research, Policy, Practice: Proceedings of ICEM 2018 Conference* (pp. 3-16). Springer Singapore. https://doi.org/10.1007/978-981-13-7361-9_1

Appendices

Appendix 1 Solutions and chemical kinetics topics

No	Subject 1: Solutions	Subject 2: Chemical Kinetics
1	Dissolution, melting, homogeneous mixture, heterogeneous mixture	What is chemical kinetics? Collision theory
2	Solubility, factors affecting solubility	Activated complex, forward and reverse activation energy
3	Saturated, unsaturated and supersaturated solutions	Endothermic and exothermic reactions
4	Solubility, dissolution rate	Enthalpy change
5	Electrolyte solution	Reaction rate
6	Solubility of solids in liquids (crystals, molecular, ionic and metallic crystals)	Factors affecting the reaction rate (structure of the substance, concentration, surface area, temperature, catalyst)
7	Solute-solvent interaction (endothermic, exothermic dissolution), Le Chatelier's principle	Reaction rate-determining step
8	Hydration energy	Order of reaction
9	Solubility, solubility of solids, liquids and gases	
10	Fractional crystallisation	
11	Solution preparation, molar concentration, molality	
12	Colligative properties (freezing point depression, boiling point elevation)	
13	Osmosis	
14	Azeotropic mixtures, deviation from ideal solution	
15	Osmotic pressure	
16	Raoult's Law, mole fraction, vapour pressure	

Tools Used During Implementation Process

Kahoot Tests and Quizlet Sets

The lecturer and the researcher, who is a domain expert, prepared the Kahoot tests by preparing the verbal questions and questions requiring problem solving related to the course topics, and adapting them to the Kahoot format. The prepared tests were used in the lessons, and access links were also given to the students to answer the questions in their free time outside the online classroom.

Kahoot Tests Prepared for Solutions and Chemical Kinetics Topics

With the aim of using them in formative assessment in the study, a test named "Solutions/Solubility-I-2021" consisting of 20 verbal questions and a test named "Solutions/Solubility-II-2021" with 10 numerical questions requiring problem solving were prepared using the Kahoot application. For the subject of chemical kinetics, a test named "Chemical Kinetics I" consisting of 24 verbal questions and a test named "Chemical Kinetics II" with 10 numerical questions requiring problem solving were prepared using Kahoot.

Appendix 2 Screenshot of student logging into Kahoot in lesson conducted with online education

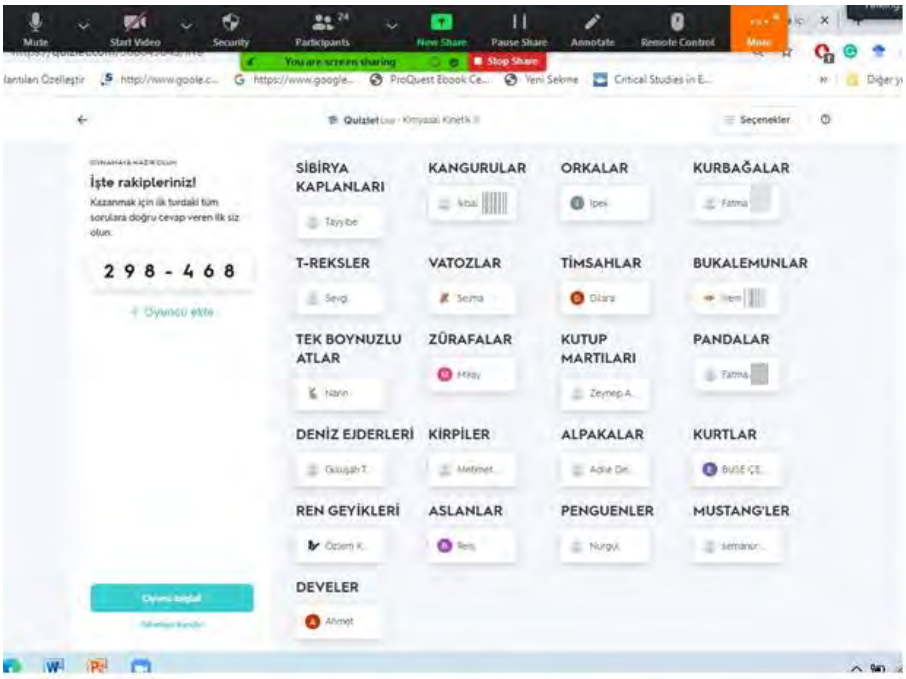
Students logged into the Kahoot application using their own names in the online lessons conducted synchronously (Appendix 2).

Appendix 3 Screenshot of question answered by student on Kahoot

In Kahoot, in addition to verbal questions, question types that require operations were also included (Appendix 3). In these types of questions, students were given more time to answer the questions.

Quizlet Sets Prepared for Solutions and Chemical Kinetics Topics

In the study, for the subject of solutions, a "Solutions/Solubility" study set consisting of 37 terms/definitions, and a "Solutions-Solubility-problems" study set consisting of 12 terms/definitions that require numerical operations on the subject of solutions were prepared. For the subject of chemical kinetics, a "Chemical Kinetics I" set containing 10 definitions/terms, and a "Chemical Kinetics II" set consisting of 7 terms/definitions that require numerical operations were prepared. These sets prepared in Quizlet were used for formative assessment as a gamification tool in the classroom. In addition, after becoming a member of the Quizlet class, the students used these sets individually whenever they wanted.

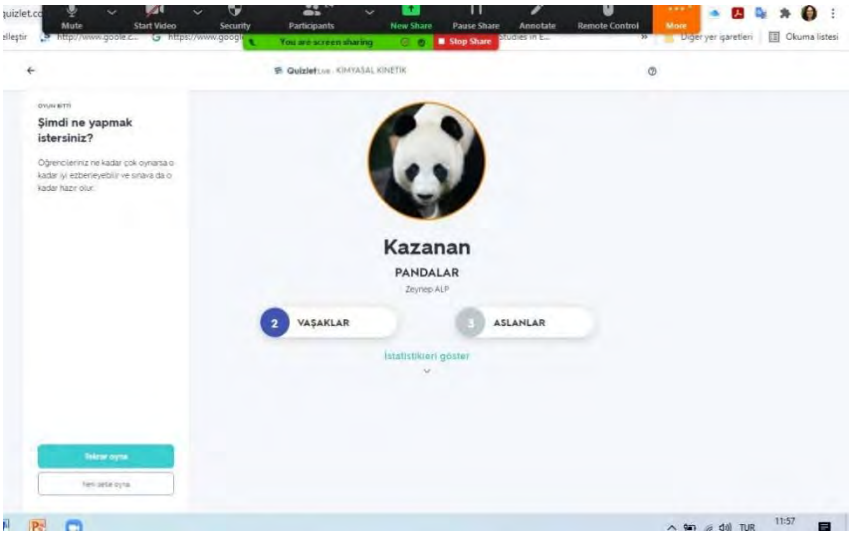


Appendix 4 Screenshot of student participating in a game individually with Quizlet Live in distance education

Students logging into the Quizlet Live application were given nicknames by the system, and student participation was thus ensured (Appendix 4).

Appendix 5 Screenshot of game progress with Quizlet Live in lesson in online education

In Quizlet Live, the students' progress and the scores they received (Appendix 5) were shared with the students, ensuring that they were informed about their progress.



Appendix 6 Screenshot of game result with Quizlet Live in lesson in online education

The results of the students who ranked the highest at the end of Quizlet Live (Appendix 6) were shared with the students.

Questions in the Student Opinion Questionnaire (SOQ)

1- How many courses did you take this semester? If you were to rank the courses you took in terms of productivity, in which place would the Chemistry II course appear? Why?

2- How often were you able participate in the online Chemistry II lessons (You can answer as all of them, most of them, a few of them, etc.)? What are your reasons for not participating in classes?

3- How often did you use the Kahoot and Quizlet applications outside the online course (You can answer frequently, sometimes, all the time, or not at all)? What are your reasons for not using them?

4- What are your views and suggestions about taking the Solutions Achievement Test (SAT) and Chemical Kinetics Achievement Test (CKAT) using Google Forms?

5- What are your views on using the Kahoot application in online lessons and in your extracurricular time?

6- What are your views on using the Quizlet application in online lessons and in your extracurricular time?
7- What has been the effect of these applications on your professional teaching skills?
8- Would you choose to use similar applications in your teaching career? Why?
9- What are your views on the use of these applications for different types of questions that require verbal and numerical processing in the chemistry course?
10- What are your views on the exams you have entered in your education life so far and the exams you have taken via Kahoot, Quizlet and Google Forms?
11- What are your different views and suggestions that you wish to express about the implementations made within the scope of this course?

FUNDING INFORMATION
This research did not receive any specific grant from funding agencies in the public, commer-cial, or not for-profit sectors.

CONFLICTS OF INTEREST
There are no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT
All data generated or analysed during this study is included in this published paper. All data is publicly available and cited.

ETHICS STATEMENT
* E- 762 441 75-752.01.01-18610 numbered ethics approval was obtained from the chairmanship of the social and human sciences ethics committee in the session numbered 2021/46, dated 12/03/2021.