Let's Play! or Don't? The Impact of UX and Usability on the Adoption of a Game-based Student Response System

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Abstract: Remote teaching emerged as an alternative to face-to-face classes during the COVID-19 pandemic. In this scenario, teachers adopt formative assessments through different approaches. One of these approaches is Game-based Student Response Systems (GSRS). Kahoot! is a prominent GSRS widely adopted in the educational context. Previous studies investigated the effects and use of Kahoot! by students. Still, none of them reports the teachers' perception of its Usability and User Experience (UX), attributes that influence the tool's adoption. This paper presents the usability and UX evaluation of Kahoot! from the point of view of teachers and students. To comparatively visualize the difference in the experience of the two profiles of platform users, we included five students and five teachers in the study. The evaluation results showed that teachers were more dissatisfied, although the positive and negative emotions were similar for the two profiles. We then conducted interviews with the teachers to understand the motives behind their dissatisfaction. The interviews helped us determine which aspects related to usability and UX teachers perceived as critical during the use of Kahoot!.

1 INTRODUCTION

Due to the pandemic of the New Coronavirus-COVID-19 (WHO, 2020), social isolation measures were adopted to combat the proliferation of the new virus, directly impacting the continuity of in-person classes. Teaching activities became predominantly remote in most countries to minimize the effects caused by isolation during the school period (Misirli and Ergulec, 2021). With that, even lecturers and institutions that were previously resistant to the insertion of new technologies had to adapt their practices and methods. Consequently, the classes needed to become more dynamic to promote student engagement (Dhawan, 2020).

However, according to Wang and Tahir (2020), most teachers agree that maintaining students' concentration, motivation, and active participation during a class is challenging.

In this context, formative assessments urge as an alternative to foster student's engagement. It affects students' motivation and promotes active involvement in their learning (Marchisio et al., 2020). Formative assessment comprises activities to support students during their knowledge acquisition, providing evidence-based support that helps them assess the quality of their progress (Marchisio et al., 2020). One of the ways to implement it in the current scenario is through Game-Based Student Response Systems (GSRS) (Wang and Tahir, 2020). GSRSs incorporate gamification elements into Student Response Systems (SRSs), used to present multiple-choice questions, enabling students to solve them together (Owen and Licorish, 2020; Wang, 2015).

An example of a GSRS that has been growing in recent years is Kahoot!, a platform designed to meet the needs of students and education professionals who want to create, practice, and share learning games in an attractive and engaging setting (Wang and Tahir, 2020; Kahoot!, 2021). Furthermore, Kahoot! has also been frequently used to review knowledge and carry out formative assessments (Wang and Tahir, 2020).

Since the launch of Kahoot!, researchers have

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published many studies of its effects in the classroom. Wang and Tahir (Wang and Tahir, 2020) analyzed 93 studies that address the effect of using Kahoot! for learning and raised the perceptions of students and teachers about using the tool. However, they do not report any issues or perceptions about the platform regarding its ease of use or usability and user experience (UX), especially from teachers' perspectives. We understand that usability and UX influence the acceptance or rejection of a system, as they are essential aspects in adopting tools by users. Therefore, they are pertinent to be investigated in depth (Hassenzahl, 2018; Van der Heijden, 2004).

This paper investigates teachers' perceptions regarding the usability and UX of Kahoot!. We chose Kahoot! as the object of study because it is one of the most used GSRS today, and it is also suitable for carrying out formative assessments in remote environments(Wang and Tahir, 2020; Wang, 2015). We chose the teacher's point of view because it is essential to create and maintain an updating environment to construct knowledge, which occurs with the support of technological tools in the online environment (Heitink et al., 2016). The choice of technology and its integration into the classroom largely depend on initial teacher adoption.

We conducted the evaluation using Usability Tests with the Cooperative Evaluation technique (Dix et al., 2004) and UX Evaluations with AttrakDiff (Hassenzahl et al., 2003), PrEmo (Du, 2019) and semi-structured interviews (Longhurst, 2003). Five teachers and five students participated in the evaluations to verify if Kahoot! would present satisfactory results for the two user profiles, on the mobile and desktop version of Kahoot!. However, we interviewed the teachers who participated in the study to raise their perceptions of usability and UX and identify whether they influenced the adoption and use of Kahoot! in online classes.

Through the investigation results, this paper presents information related to the usability and UX of Kahoot!, which can encourage improvements in GSRSs tools, especially for the teacher profile. We hope to contribute to developing technologies that bring good usability and UX to students and teachers.

2 BACKGROUND AND RELATED WORKS

Game-based learning enables new interactions between teachers and students, transforming lessons into more dynamic, engaging, and collaborative activities (Wang and Tahir, 2020; Nicholson, 2015). Several studies demonstrate that most game-based learning tools such as GSRSs have a positive effect compared to traditional learning methods (Wang and Tahir, 2020; Wang and Lieberoth, 2016).

2.1 Game-based Student Response System

Game-based learning environments utilize game principles and apply them in the learning context to make users more engaged and invested in their learning (Cárdenas-Moncada et al., 2020; Pho and Dinscore, 2015). A new generation of SRSs has been popularized in the last decade, the GSRSs. The new generation adds game-based learning elements such as ranking, sound effects, rating, and nicknames (Cárdenas-Moncada et al., 2020; Wang et al., 2019). GSRSs are interactive learning tools that allow students to answer questions in real-time, obtain class performance statistics, and participate in formative assessments (Owen and Licorish, 2020; Cárdenas-Moncada et al., 2020).

Empirical studies show that GSRSs positively impact student learning, motivation and focus (Cárdenas-Moncada et al., 2020; Owen and Licorish, 2020). For teachers, these are essential characteristics of engagement in a remote context (Capone and Lepore, 2021). An example of GSRS that has become popular in recent years is Kahoot! (Wang and Tahir, 2020). In Kahoot!, the classroom becomes a game show, with the teacher playing the presenter role and the students becoming competitors (Cárdenas-Moncada et al., 2020; Wang, 2015). Kahoot! has as its primary focus on engagement through gamification, where students are motivated to collaborate and compete in teams or individually through interactive quizzes, aiming to obtain a higher ranking (Wang and Tahir, 2020; Wang et al., 2019).

Kahoot! is considered the most popular and currently the most used GSRS (Wang and Tahir, 2020). Its popularity and use in classrooms have motivated several studies evaluating its effects on students and the teaching process.

2.2 Studies Evaluating Kahoot! and Similar Tools

Wang and Tahir (2020) performed a literature review of 93 studies focusing on the following research topics: the effect on learning using Kahoot!, how Kahoot! affects the classroom dynamic, how Kahoot! affects student anxiety, the students' perceptions about how Kahoot! affects their learning and how Kahoot! affects teachers' perceptions.

However, while the authors report the teachers' perceptions, it focuses on a single teacher profile, most engaged with technologies.

Wang and Tahirs' literature review also highlighted that there had been a notable increase in publications of articles related to Kahoot!. Among the selected papers, about 88% focus on investigating how students perceive the use of Kahoot! in learning, 39% focus on acquired learning, 35% focus on the impact of dynamization in the classroom, and only 11% focus on how Kahoot! affects teachers' perception, highlighting a possible gap to be studied and discussed.

Studies such as those by Göksün and Gürsoy (2019), Licorish and George (2018), and Wang (2015) also discuss user perception and increased engagement when using various GSRSs in the classroom. However, they do not directly address perceptions or evaluations regarding the usability and UX of these tools. Moreover, despite the review of Wang and Tahir (2020) briefly exposing the teachers' perspective on Kahoot!, it only emphasizes pedagogical or technical challenges related to its implementation, not presenting relative perceptions on the ease of use, usability, or experience of using the platform.

2.3 Usability and UX in Learning Tools

According to the ISO (ISO, 2019), Usability is "the extent to which a system, product or service can be used by users to achieve certain goals with effectiveness, efficiency, and satisfaction in a certain context of use". As stated by Nielsen and Loranger (2006), the concept of usability is related to five criteria: learning, memorization, error prevention, efficiency, and satisfaction.

The ISO 9241-210:2019 defines User Experience (UX) as "user perceptions and responses resulting from the use or anticipation of the use of a product, system or service". In addition, it states that user experience is related to three main criteria: usefulness, ease of use, and pleasure (ISO, 2019). The user experience encompasses all aspects of the interaction with a product. It contains their perceptions and responses, related to pragmatic aspects, linked to objectives and effective and efficient means of manipulating the environment, and hedonic aspects, linked to the individuals' self and their psychological well-being, providing stimulation, identification, or provoking memories(Hassenzahl, 2018).

The increasing number of software on the market made improving the quality of these products a differential for their success and expansion (Beauregard et al., 2007). Among the efforts made to improve the quality of these products, we can mention the Usability Tests (Lewis, 2006) and the UX evaluations (Vermeeren et al., 2010).

In a usability-testing session, evaluators observe one or more participants while performing specific tasks with the product in a test environment (Lewis, 2006). Amid the different existing techniques for carrying out usability tests, the Cooperative Evaluation technique (Dix et al., 2004) encourages the user to criticize the system under evaluation and allows evaluators to clarify confusing points at the time of application from the test (Følstad and Hornbæk, 2010; Dix et al., 2004). UX evaluations (Vermeeren et al., 2010) are assessments used to obtain evidence about using a specific technology by collecting UX data (Rivero and Conte, 2017).

We used three techniques to collect UX data: Product Emotion Measure (PrEmo) (Du, 2019), AttrakDiff (Hassenzahl et al., 2003), and Semi-structured Interviews (Longhurst, 2003). PrEmo is a non-verbal self-report method that measures fourteen emotions that are often triggered by the product experience. Of these emotions, seven are pleasant (admiration, joy, desire, pride, hope, fascination, and satisfaction), and seven are unpleasant (sadness, fear, dissatisfaction, shame, monotony, disgust, and contempt) (Desmet, 2018; Laurans and Desmet, 2017; Du, 2019). AttrakDiff, on the other hand, assesses user feelings using a questionnaire with twenty-eight items, in addition to studying the hedonic and pragmatic dimensions of UX with semantic differentials. The results are quantitative and comparative data, which assess the perception of the experiences, not the actual experiences (Hassenzahl et al., 2003).

Moreover, to collect more detailed information regarding the perceptions of use, we conducted Semi-structured interviews, a verbal approach where the researcher and subjects exchange information through questions and answers while maintaining the flexibility to investigate essential points by including more questions (Longhurst, 2003).

3 METHODOLOGY

Given the influence of Usability and UX on the acceptance and adoption of a system (Hassenzahl, 2018; Van der Heijden, 2004), we carried out a study to evaluate such attributes in the Kahoot! tool. Our work contributes to the gap identified in the literature regarding the Usability and UX Evaluation of GSRSs.

To evaluate the tool from a more general point of view, we included teachers and students in the initial phase of the study.We used Kahoot! in its two available versions, mobile and desktop.

The evaluation took place virtually through Google Meet, where we invited participants to perform the objectives and tasks proposed to them in Kahoot!. This stage constituted the Usability Test (Lewis, 2006), and the technique used was the Cooperative Evaluation (Dix et al., 2004). At the end of each objective and task performed by the participants, they answered an online form through Google Forms to report their emotions by choosing images that represented them. This activity was part of the UX Evaluation (Vermeeren et al., 2010), using the technique PrEmo (Du, 2019). After completing all the objectives proposed for the evaluations, the participants were invited to characterize their experience of using the platform in an online questionnaire[1] using the AttrakDiff technique (Hassenzahl et al., 2003). The last stage of the UX Evaluation consisted of an interview with the teachers that participated in the study.

3.1 Participants

The Usability Test and UX Evaluation included ten participants aged between 18 and 60 years: five teachers from different backgrounds and five university students. One of the criteria for selecting the participating teachers was that they had never used Kahoot! in their classroom. However, the previous use of the tool with the student profile was not an exclusion factor. For the participating students, we required that they had no previous experience with the platform. Furthermore, we considered only the teachers for the interview stage because we wanted to understand what they disliked about the platform.

3.2 Usability Test

To carry out the Usability Test, we established a roadmap with the general objectives of the participants, which are available in the complementary materials (Rodrigues et al., 2022). For teachers, we set the following objectives:

- Objective 1: Explore the access and registration on the Kahoot! website as a teacher.
- Objective 2: Explore creating kahoots.
- Objective 3: Explore Kahoot!'s gameplay.
- Objective 4: Explore the settings.
- Objective 5: Explore Kahoot!'s groups.

For the students, we defined the following objectives:

- Objective 1: Explore the access and registration on the Kahoot! website as a student.
- Objective 2: Explore Kahoot!'s gameplay.
- Objective 3: Explore Kahoot!'s gameplay.
- Objective 4: Explore the "Discover" section.

We adopted four metrics during the Usability Test: "Time taken to complete a task," measured in seconds, "Number of errors made," "Numbers of times the participant expressed confusion," and "Numbers of times the participant asked for help from the moderator." We established these metrics according to their impact on the user experience. For example, the fact that the participant fails to complete a task is severe. It indicates that using the application is highly frustrating and prevents its proposal from being effectively achieved.

3.3 UX Evaluation and Interviews

We performed UX Evaluation with the PrEmo technique right after the Usability Test, after the participant completed an objective and the proposed tasks. We aimed to obtain an immediate perception of the activities. The AttrakDiff questionnaire was applied after the participants completed all the proposed objectives for the Usability Test. After analyzing the results of both techniques, we conducted interviews with the teachers to investigate their perceptions regarding the usability and user experience of Kahoot and the impact these perceptions' would have on teachers' adoption of the platform in online classes.

The complete interviews had twenty guiding questions available in full at (Rodrigues et al., 2022). Given that some teachers had previous experience as students, the interview questions were mainly about their experience with the platform, before and after the first use. We also aimed to raise their impressions regarding Kahoot!'s interface and whether or not they would adopt it in their online classes.

4 RESULTS AND DISCUSSION

This section presents the results obtained in the Usability Tests and UX Evaluations performed with teachers and students. We also present teachers' perceptions on the use of Kahoot! as a result of the semi-structured interviews.

4.1 Usability Test: Cooperative Evaluation

After analyzing the results obtained through the Cooperative Evaluation(Rodrigues et al., 2022), we observed that the participants had difficulties achieving

[1] http: //www.attrakdiff.de

some objectives and their respective tasks. Teachers had more significant challenges with objective 2 (Explore creating kahoots) and objective 3 (Explore Kahoot!'s gameplay.). Some participants reported the **lack of consistency** of the platform. Although Kahoot! was configured to their local language, it presented some pages and terms in English, demonstrating a **lack of standardization**.

Regarding Objective 3, we had higher errors and the number of times that the participant expressed confusion. It demonstrates that teachers found it more challenging to perform than the other proposed activities. Once again, we can observe that Kahoot! does not present **straightforward navigability**.

4.2 UX Evaluation

In the UX Evaluation, we observed the experiences perceived in pragmatic and hedonic terms that Kahoot! brought to the participants. Below, we present in more detail the results of PrEmo and AttrakDiff.

4.2.1 *PrEmo*

This method measured the UX through the emotions reported by the participants when performing the Goals and Tasks defined for the Usability Test. The results achieved are available in (Rodrigues et al., 2022).During UX Evaluations, teachers reported emotions like satisfaction, dissatisfaction, and monotony. The first emotion is classified as a positive emotion and the following as negative or neutral emotions. The number of negative emotions was close to the number of positive emotions, where 95 were negative, and 91 were positive. This result demonstrates that **teachers felt neutral** about the experience of using the tool.

In the student's results, the most reported emotions were: satisfaction and joy, which are classified as positive. Therefore, we conclude that the students' experience was good when performing the proposed objectives and tasks, as positive emotions were pointed out 77 times, against 41 reports of emotions classified as negative or neutral.

4.2.2 *AttrakDiff*

In Figure 1, we can observe that the teachers' experience was not as positive as that of the students. Some words chosen among the pairs were on the horizontal axis with values close to 0 and some close to -1. This result indicates that teachers rated Kahoot! as **technical, confusing, and ordinary**. Therefore, teachers consider that these attributes of Kahoot! can be improved.

We can observe that the teacher's experience, in general, was less satisfactory. Teachers expressed more neutral results and minor variance, indicating the opportunity to improve Kahoot!. On the other hand, students showed an increasing and positive result, as their mean values are all positive and some are higher than 1. In (Rodrigues et al., 2022) we can see the average values of the dimensions PQ and HQ.

PQ-related results describe Kahoot!'s usability and how users achieve the objectives when using it. Figure 2 shows that teachers believed that Kahoot! would help them achieve their goals on the platform. However, they also had reservations, as their indicative values of pragmatic qualities are close to zero. On the other hand, students expressed higher values regarding pragmatic qualities, demonstrating that they were more confident that the platform would help them achieve the proposed objectives. The results of the HQ-I dimension, which explores users' identification with Kahoot!, indicated that the platform generated similar identification in students and teachers. Regarding the HQ-S, which indicates how much Kahoot! meets the users' needs in generating interest and stimulation, we can see that the tool also offered similar stimulation and motivation in teachers and students. As for the ATT, which describes the general quality of Kahoot! perceived by users, we can infer that teachers perceived the platform as less attractive than the students, as its numbers were closer to zero.

Figure 2 shows that students' experience was generally positive and without significant variations in terms of perceptions, as their values for PQ, HQ-I, and ATT remained moderate, with attention only to the HQ-S dimension. As its value was closer to zero, we infer that the platform was moderately stimulating.

According to Figure 2, the average values of the pragmatic quality in the teacher's point of view (PQ=0.10) were lower than when considering the perceptions of the students (PQ=0.96). It indicates that teachers rated Kahoot! less efficient and effective than students. Moreover, the average hedonic quality was slightly lower for teachers (HQ=0.77) than for students (HQ=0.79), implying that teachers had a less significant stimulus in using the platform.

4.2.3 Interviews

According to the data collected during the interview, teachers pointed out the good relationship of the students with the GSRS, as some students already showed interest in using Kahoot! in the classroom, which motivated them to adopt the platform. Besides that, teachers who had already used Kahoot! as a students had positive memories of its use. It influenced

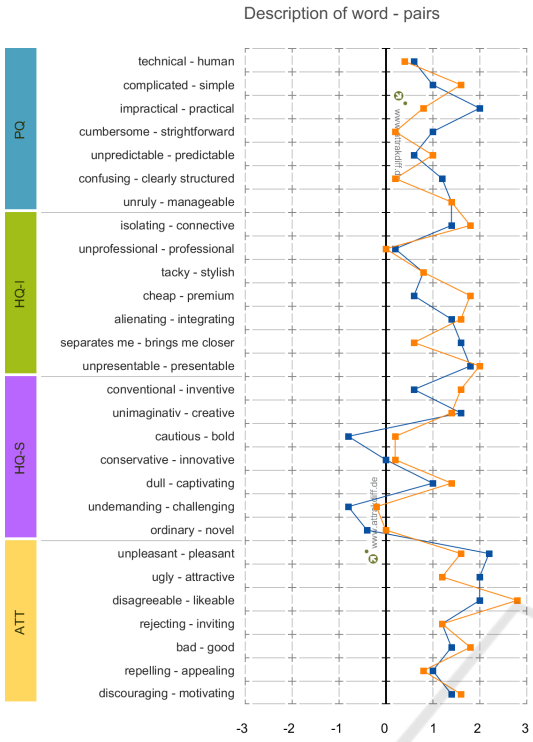

Figure 1: Teacher's and Student's pair of words.

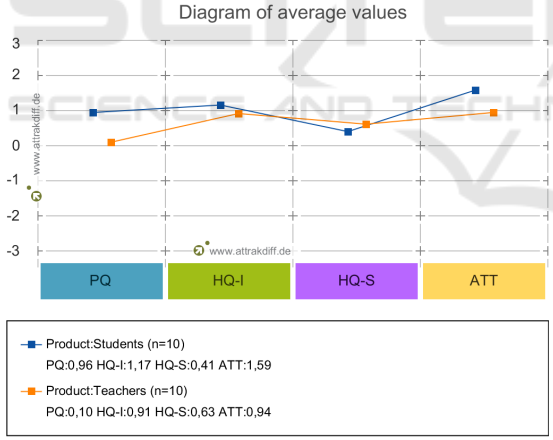

Figure 2: Diagram of average values of *AttrakDiff* dimensions.

them to want to adopt the tool in their classrooms. "Kahoot! brought me a vision of when I was a student, and I wanted my students to feel the stimulation I felt as a student, all in a dynamic, cool, and fun way through a competition…", reported one of the teachers.

However, this previous positive experience using the features developed for students promoted high expectations in the teachers. When teachers use their specif resources of the tool and their expectations are not met, they feel frustrated. We can observe that when one of the teachers with previous experience as a student says: "This thing of creating an expectation is terrible, because when I used it for the first time it was as a student, and I thought it was cool, pretty and easy to use. So I thought I would like to use it in my classrooms and show it to my students. I thought it would be easy for me as a teacher to use, and it wasn't."

Teachers who never tried Kahoot! but were receptive to using new technologies to streamline classes and carry out formative assessments, reported dissatisfaction with the **lack of platform standards**. They reported issues related to the language and the lack of intuitiveness in the interface to achieve the proposed objectives, such as the creation of new kahoots. We captured some screenshots of interface issues that teachers reported(Rodrigues et al., 2022).

Regarding the interface problems teachers reported, we can cite:

- An **interface that is not visually pleasing** and **has solid colors** is tiring for the eyes;
- **Functions that are difficult to access** and that are not simply arranged, as well as **symbols that are confusing and difficult to understand**;
- **Difficulty in using some features**, such as adding media to the created kahoot.

4.3 Discussion

After analyzing the results of the Usability and UX Evalution with the PrEmo and AttrakDiff techniques, we found that the teachers presented results that tended to be slightly negative but primarily neutral. However, they reported being dissatisfied with Kahoot!'s usability and UX. This divergence motivated us to interview teachers to understand their dissatisfaction, despite the neutral results.

Some teachers had their first contact with Kahoot! as pre-study students. However, when they tried the resources developed for teachers, it did not live up to their expectations. Possible factors contributing to this frustration are the **difficulty of use in essential tasks** and increased **handling complexity** during the execution of the tasks, as shown in the results of the Cooperative Evaluation and AttrakDiff. We can also attribute teachers' dissatisfaction to the **loss of the playful, pleasant, and easy-to-handle aspect** that the tool brought in its interface for student profile, as evidenced in the interviews.

Teachers who first used Kahoot! with the teacher profile tended to have more negative opinions about the platform. These teachers highlighted that for a

better acceptance of the platform in their pedagogical practices, it would need improvements in terms of usability and UX for the teacher's profile.

Although Kahoot! did not meet teachers' expectations, some of them wanted to adopt the tool. The main factor was the desire to provide their students with the same positive experience they had previously as students on the platform, even if they had to overcome obstacles and challenges. Consequently, the fact that some teachers were already motivated to use Kahoot! in their classes may have influenced the neutrality of the evaluation results. However, even a previous motivation was not enough to change the perceptions after using Kahoot! as a teacher.

Regarding problems perceived in the platform interface, we observed that elements such as the color scale needs reassessing, as the participating teachers didn't accept them well. Teachers related **problems regarding the interface's intuitiveness**, such as features that are not easily accessible and symbols that are confusing and difficult to understand. We believe that corrections and GSRSs projects that consider Nielsen's heuristics (Nielsen and Molich, 1990) could meet many of these improvement requests, aiming the development of easy-to-navigate interfaces providing better interaction and experience for target users.

Based on the results, it is possible to verify that they are complementary to the results obtained in other studies such as Wang and Tahir (2020), as they bring the teacher's perspective of using the tool. This angle has been little addressed and investigated, despite the importance of the teacher's role in accepting and using technologies in classrooms. Therefore, this work complements existing studies, highlighting harmful elements and opportunities for improvement regarding the usability and UX of a GSRS, such as Kahoot!, for the teacher profile.

5 CONCLUSION

Considering that the adoption of technological tools in pedagogical practices is the teacher's responsibility, these tools need to offer good usability and UX for them. Even though teachers and students use different functionalities on the platform, we expected that the experiences would be satisfactory for all users.

Thus, this paper presented the usability and UX evaluation of Kahoot! and analyzed whether these factors impacted teachers' adoption of the tool. As a result, we identified that the platform promoted a better user experience for students and presented more usability and UX problems for teachers. To better understand the teacher's results, we performed interviews to collect their perceptions while using the platform and whether this would impact its adoption in their classrooms or use for conducting formative assessments. The results reinforced that teachers were already motivated to adopt the platform, primarily because of its success among students. However, after its use with the teacher profile, their perception became negative, causing them to condition the future use of the tool in online classes or in carrying out formative assessments, only if improvements were made in this regard.

Such information is essential for software developers, as it helps them identify and avoid problems similar to those reported by teachers regarding Kahoot!'s usability and UX.

As future work, we suggest carrying out more robust studies with more GSRSs that raise problems different from those mentioned in this research and investigate how to make the UX and usability of GSRSs positive for teachers and students.

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REFERENCES

Beauregard, R., Younkin, A., Corriveau, P., Doherty, R., and Salskov, E. (2007). Assessing the quality of user experience. *Intel Technology Journal*, 11(1).

Capone, R. and Lepore, M. (2021). From distance learning to integrated digital learning: A fuzzy cognitive analysis focused on engagement, motivation, and participation during covid-19 pandemic. *Technology, Knowledge and Learning*, pages 1–31.

Cárdenas-Moncada, C., Véliz-Campos, M., and Véliz, L. (2020). Game-based student response systems: The

impact of kahoot in a chilean vocational higher education efl classroom. *Computer-Assisted Language Learning Electronic Journal (CALL-EJ)*, 21(1):64–78.

Desmet, P. (2018). Measuring emotion: Development and application of an instrument to measure emotional responses to products. In Blythe, M. and Monk, A., editors, *Funology 2*, pages 391–404. Springer, Cham.

Dhawan, S. (2020). Online learning: A panacea in the time of covid-19 crisis. *Journal of Educational Technology Systems*, 49(1):5–22.

Dix, A., Finlay, J., Abowd, G. D., and Beale, R. (2004). *Evaluation Techniques*, pages 318–363. Prentice Hall, Harlow, third edition.

Du, Y. (2019). PrEmo toolkit: Measuring emotions for design research. Master's thesis, Delft University of Technology, Delft, Países Baixos.

Følstad, A. and Hornbæk, K. (2010). Work-domain knowledge in usability evaluation: Experiences with cooperative usability testing. *Journal of systems and software*, 83(11):2019–2030.

Göksün, D. O. and Gürsoy, G. (2019). Comparing success and engagement in gamified learning experiences via kahoot and quizizz. *Computers & Education*, 135:15–29.

Hassenzahl, M. (2018). The thing and i: Understanding the relationship between user and product. In *Human–Computer Interaction Series*, pages 301–313. Springer International Publishing.

Hassenzahl, M., Burmester, M., and Koller, F. (2003). Attrakdiff: A questionnaire to measure perceived hedonic and pragmatic quality. In *Mensch & Computer*, volume 57, pages 187–196.

Heitink, M., Voogt, J., Verplanken, L., van Braak, J., and Fisser, P. (2016). Teachers' professional reasoning about their pedagogical use of technology. *Computers & education*, 101:70–83.

ISO (2019). Iso 9241-210: 2019 ergonomics of human-system interaction—part 210: Human-centred design for interactive systems. https://www.iso.org/standard/77520.html.

Kahoot! (2021). About Kahoot! — Company History & Key Facts. https://kahoot.com/company/.

Laurans, G. and Desmet, P. M. A. (2017). Developing 14 animated characters for non-verbal self-report of categorical emotions. *Journal of Design Research*, 15(3-4):214–233.

Lewis, J. R. (2006). Usability testing. In *Handbook of Human Factors and Ergonomics*, volume 12, page 1275–1316. John Wiley, New York.

Licorish, S. A., Owen, H. E., Daniel, B., and George, J. L. (2018). Students' perception of kahoot!'s influence on teaching and learning. *Research and Practice in Technology Enhanced Learning*, 13(1).

Longhurst, R. (2003). Semi-structured interviews and focus groups. *Key methods in geography*, 3(2):143–156.

Marchisio, M., Fissore, C., and Barana, A. (2020). From standardized assessment to automatic formative assessment for adaptive teaching. In *12th International Conference on Computer Supported Education*, volume 1, pages 285–296. SCITEPRESS.

Misirli, O. and Ergulec, F. (2021). Emergency remote teaching during the covid-19 pandemic: Parents experiences and perspectives. *Education and Information Technologies*, pages 1–20.

Nicholson, S. (2015). A RECIPE for meaningful gamification. In *Gamification in education and business*, pages 1–20. Springer.

Nielsen, J. and Loranger, H. (2006). *Prioritizing Web Usability*. New Riders Publishing, USA.

Nielsen, J. and Molich, R. (1990). Heuristic evaluation of user interfaces. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 249–256.

Owen, H. E. and Licorish, S. A. (2020). Game-based student response system: The effectiveness of kahoot! on junior and senior information science students' learning. *Journal of Information Technology Education: Research*, 19:511–553.

Pho, A. and Dinscore, A. (2015). Game-based learning. *Tips and trends*.

Rivero, L. and Conte, T. (2017). A systematic mapping study on research contributions on ux evaluation technologies. In *Proceedings of the XVI Brazilian Symposium on Human Factors in Computing Systems*, pages 1–10.

Rodrigues, M., Nery, B., Castro, M., Klisman, V., Duarte, J. C., Gadelha, B., and Conte, T. (2022). Let's play! or don't? the impact of ux and usability on the adoption of a game-based student response system: Supplementary materials. https://bit.ly/3vOPSRi.

Van der Heijden, H. (2004). User acceptance of hedonic information systems. *MIS quarterly*, pages 695–704.

Vermeeren, A. P., Law, E. L.-C., Roto, V., Obrist, M., Hoonhout, J., and Väänänen-Vainio-Mattila, K. (2010). User experience evaluation methods: current state and development needs. In *Proceedings of the 6th Nordic conference on human-computer interaction: Extending boundaries*, pages 521–530.

Wang, A. I. (2015). The wear out effect of a game-based student response system. *Computers & Education*, 82:217–227.

Wang, A. I. and Lieberoth, A. (2016). The effect of points and audio on concentration, engagement, enjoyment, learning, motivation, and classroom dynamics using Kahoot! In *10th European Conference on Games Based Learning (ECGBL 2016)*, pages 738–746. Academic Conferences International Limited.

Wang, A. I. and Tahir, R. (2020). The effect of using Kahoot! for learning – a literature review. *Computers & Education*, 149.

Wang, W., Ran, S., Huang, L., and Swigart, V. (2019). Student perceptions of classic and game-based online student response systems. *Nurse educator*, 44(4):E6–E9.

WHO (2020). Coronavirus disease — (COVID-19). https://www.who.int/news-room/q-a-detail/q-a-coronaviruses.