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Providing Students With Mobile Access to an Assessment Platform:
Lessons Learned

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ABSTRACT

The growing ubiquity, rich functionality, and relative affordability of mobile devices have been seen as opportune factors for implementing mobile learning solutions that can be used in a variety of contexts and domains. Plenty of successful mobile educational applications have been built. This paper describes an attempt to build on this success. The authors have investigated the use of mobile devices by students accessing assessment and self-assessment quizzes in the context of a university course. Two experiments were conducted with undergraduate students. The results of the first experiment were not successful, and initially, very few students used mobile devices. After several adjustments, during the second experiment, the usage of the system increased. However, the numbers were still much lower when compared to desktop access. This paper reports an investigation into the lack of mobile usage of the developed platform despite the educational affordances brought by mobile devices.

KEYWORDS

Assessment, Blended Learning, Evaluation, Mobile Learning, Responsive Design, Self-Assessments, Voting Tool

INTRODUCTION

The widespread use of mobile devices among students leads to a shift in learning practices. Compared to other computing devices, mobile phones have a range of advantages, including portability, a rich set of sensors and supported functions, connectivity, etc. (Pellerin, 2018). At the same time, the computational, presentation and interface capabilities of modern mobile devices have become so advanced that a typical user rarely has to sacrifice richness of interaction and functionality for utility and mobility (MacCallum et al., 2017). Moreover, for many tasks, mobile devices have become a more convenient platform. In the domain of education, there exist a few notable examples of extremely effective mobile learning applications. For instance, Duolingo is a language learning app that helps its users to gradually build up knowledge of vocabulary, grammar, listening, writing, and even speaking

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by practicing with many types of assessment exercises on a variety of topics (Loewen et al., 2019). Interestingly, Duolingo has a browser-based version that can be accessed on the desktop. Yet, most of its traffic comes from mobile devices. Duolingo users voluntarily engage with a plethora of educational content through their phones. What mobile devices successfully bring to the fore is the innate support of self-regulated learning. Being affordable, portable, and connected they are constantly available as potential learning tools for all categories of learners. Hence, it seems natural to use them as the platform of choice for developing solutions that support students when they are trying to learn on their own. Another type of mobile tool that has been widely and successfully adopted in education are quiz/polling tools such as Kahoot! (Wang & Tahir, 2020). Once again, affordability, portability, and ease of use of mobile devices are great assets for organizing on-the-spot assessment with such apps.

This paper aims to explore the factors of this success. An assessment platform – called Quizitor – has been developed. It can be used both in class (for on-the-spot assessment) and at home (for self-assessment). The platform was developed as a web application using the responsive design methodology. Hence, it was accessible through a browser on both mobile and desktop platforms and was purposefully designed to look and feel user-friendly on both platforms. The decision to focus on (self-)assessment as a learning activity had several motivations. Assessment and self-assessment are active and meaningful learning tasks that help to break the mundane routine of in-class lectures and at-home reading. They allow students opportunities to practice, monitor and reflect on their knowledge and, potentially, achieve deeper understanding of the course material. Assessment can become a key factor to improve students' learning (Rocha et al., 2020) and help them reach higher scores on exams (Riggs et al., 2020). In addition, the already mentioned success of other practice-based mobile platforms such as Duolingo is a good indicator that students are willing to engage with assessment material on their mobile devices.

Overall, in terms of student learning, mobile devices are known to provide several affordances that can be utilized for educational purposes. According to Parsons et al., (2016), there are at least six affordances that can support learning, i.e., portability, data gathering, communication, outdoor activities, contextual learning, and interaction with the interface. It has been shown that these factors can enhance learning in general (Palalas & Wark, 2020) and independent learning in particular (Alrasheedi et al., 2015). In mobile learning scenarios, students often need to regulate their learning, for instance, when applying resource management strategies (Hartley et al., 2020). They plan themselves when and where to engage with learning material and have the agency to select the material they find most relevant (Mwandosya et al., 2019). In addition, mobile learning scenarios are naturally compatible with various technologies for learning support, such as adaptive learning and collaborative learning (Lazarinis et al., 2017). For example, it seems more effective to send learning-related personalized messages to the device that students carry with them all the time. It increases the chance that a student receives the message at the right time. It is also easier and faster to seek help and communicate with mobile devices. Such support can lead to better academic performance (Hsiao et al., 2019).

Quizitor does not yet implement learning support technologies. The first idea was to investigate the patterns of students' activity with the platform, identify difficulties that they might experience and use it to inform the further development of support capabilities of Quizitor. The hypothesis was that students would be actively using the mobile version of the platform. An experiment was conducted in an undergraduate university course. The results have shown that only a few students used mobile devices to interact with Quizitor. After several measures that facilitated accessing the platform, another experiment showed that the number of mobile users increased, yet the overall usage remained low compared to the desktop version of the interface. This paper reports the results of this evaluation and attempts to analyze the factors that might have dissuaded students from using their mobile devices when interacting with Quizitor.

RELATED WORK

As mobile technologies gain popularity among students, many studies have investigated the effectiveness of integrating these technologies into the learning activities. A study by van Rensburg et al. (2022) reported the positive impact of using mobile technologies for learning in terms of increasing learning opportunities for students. Assessment as part of learning activities has become one of the domains that draws the attention of mobile learning researchers. Unlike many other activities, assessment allows students to practice and receive feedback on their performance (Schön et al., 2012), helps them increase their overall motivation (Cheong et al., 2013) and engage with learning (Riggs et al., 2014). It also contributes to improving students' self-regulated learning abilities (Rocha et al., 2020). In self-regulated learning scenarios, assessments can be used to measure students' ability to plan, perform, and evaluate their learning activities (Cucchiara et al., 2014).

Quizzes are a common type of assessment. Conducting an effective quiz could be challenging, especially in a large and diverse classroom. Several approaches on using mobile devices for assessment have been reported in the literature. Gamification has been one of the popular methods to enhance the use of mobile technologies in education in general, and in assessment in particular. Gamified assessment tools have been used to increase student engagement through such elements as badges, streaks, and leaderboards, which can have a positive effect on students' engagement and learning experiences (Cheong et al., 2013). Another study by Lazarinis et al. (2017) investigated the effectiveness of assessment in a mobile context as an exam preparation tool. The results showed a positive impact of using the tool on the average exam score. Furthermore, the adoption of a familiar mobile technology can be an option to increase student engagement during assessment (Shoesmith et al., 2020). A similar result was reported in Bacca-Acosta and Avila-Garzon (2021), where the use of a mobile tool for formative assessment improved student engagement with the assessment activity.

The results mentioned above have been collected using tools developed for research purposes. To gain a more practical perspective on how mobile technologies are utilized in education, it is interesting to analyze the successful commercial apps that are used in real learning scenarios. Two prominent examples that motivated the current study are Duolingo and Kahoot! Duolingo is a widely known language learning tool. It has become the most popular learning app with around 50 million active monthly users in 2022 (Duolingo, 2022). A systematic review by Shortt et al. (2021) showed several insights about the use of Duolingo. First, its learning support approach mainly leans toward gamification. Mobile users are already familiar with many game elements used in mobile game apps. Thus, Duolingo fully capitalizes on familiar gaming elements, such as leaderboards, badges, daily challenges and achievements, in order to maximize students' time with the app. It capitalizes on a large user base that it has accumulated to support exploration of errors through targeted discussions. Moreover, recently, it has started providing reflective explanatory feedback to students based on their answers. Kahoot!, on the other hand, is a generic quiz tool that can be used in various domains. In research done by Mimouni (2022), Kahoot! was used to provide a gamified approach to student assessment. It was reported to increase student motivation. In addition, further research by Chen and Hwang (2018) shows that Kahoot! increases student engagement in a flipped learning classroom.

Quizitor

For this study, a quiz platform, called Quizitor, has been developed. It can be used in two modes: for in-class assessment organized by a teacher and for at-home self-assessment that students engage with in an individual self-regulated manner. The in-class quizzes are used to introduce interactivity into the lectures and help both students and the teacher check on the spot what the overall level of understanding is within the class and, potentially, help guide remedial discussions. The in-class quizzes follow the methodology of personal response systems (Gauci et al., 2009) and their "close relatives" – voting systems (Draper & Brown, 2004). The at-home quizzes provide students with an opportunity to practice their knowledge and prepare for exams (Brusilovsky & Sosnovsky, 2005). The platform is designed to be a domain-independent tool that can be used for various courses. In this study, we report its use in a Web Technology course for undergraduate students.

The two quiz modes in Quizitor, in-class and at-home, have several main differences. First, the in-class quiz is held synchronously. It means a teacher is responsible for starting a quiz and its individual questions, deciding how long each question can be answered for, discussing the answers, and terminating the quiz. Meanwhile, the at-home quiz is intended for students' self-assessment. It means each individual student decides when to start a session with Quizitor, which questions to attempt, and how long to stay logged in. Second, in-class questions can be answered only once, while at home questions can be attempted as many times as a student wants. Third, in-class questions are less complicated, as they are designed to help students recall basic concepts in 30-60 seconds. At-home questions, on the other hand, might take much longer to figure out. There are also a few differences in the interface of the two modes. For example, once the teacher stops accepting answers to an in-class question, all students see the results page that displays a distribution of answers given to the question. The at-home version does not have such a page.

Quizitor supports several question types, including multiple-choice, short-answer, multiple-answer, and ordering. Questions are organized into quizzes, which themselves are grouped into course topics.

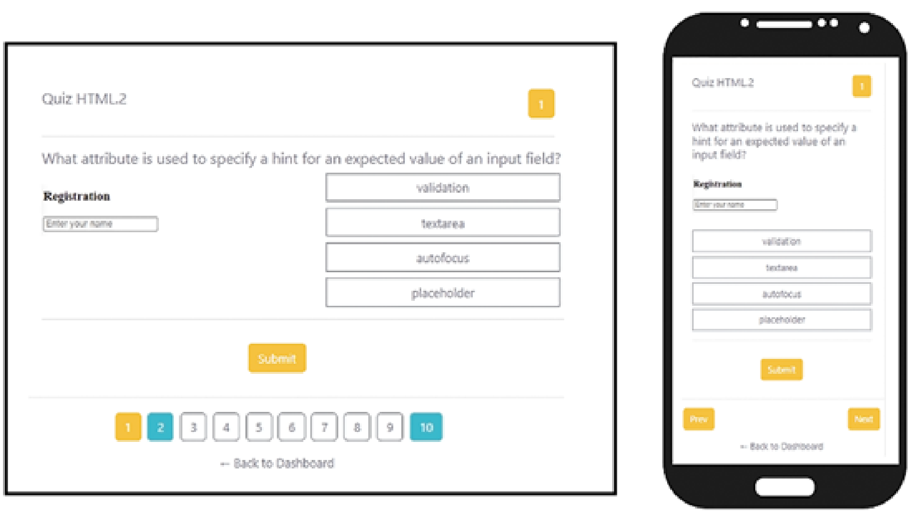
Quizitor has been built as a Web application using the responsive Web-design approach, which makes it accessible and usable from various devices. This means all its user interface components are adjusted according to the screen size of the used device. For example, Figure 1 shows the transformation of the interface from desktop to mobile screen. On the desktop, the contents are arranged side by side, whereas on the mobile screen, all contents are stacked vertically. Moreover, the navigation icons on the desktop are replaced with navigation arrows on the mobile interface. To encourage mobile usage among students, a QR code is added to the login page. According to Parsons et al. (2016), reading QR codes is one of the mobile affordances in the context of learning. Figure 2 shows the login page of Quizitor with a QR code on the left side of the screen. Students can scan this QR code and open Quizitor on their mobile devices right away.

EXPERIMENTAL DESIGN

Two experiments were conducted to investigate parameters of students' behavior regarding the devices they use for accessing Quizitor. We looked at parameters such as number of sessions, session length, and number of attempted questions to measure the usage of the platform.

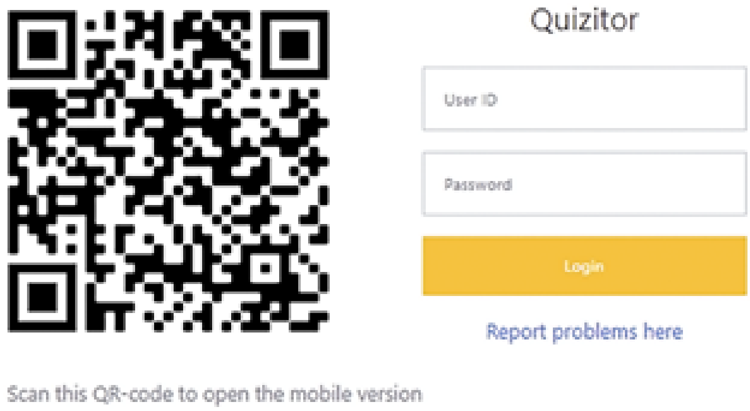
Students had given informed consent before they could participate in the experiments. Participation was voluntary, and they could stop at any point in time without any consequences. To

Figure 1.
Responsive user interface of Quizitor



(a) Desktop (b) Mobile

Figure 2.
The use of a QR-code



start using Quizitor, login details were distributed to every student. Students were informed that they could use Quizitor on their phones or desktop devices. No advice or requests regarding the type of devices were given to students. Students who signed the consent form and used the system enough (70% of questions attempted for 70% of topics) received a small extra credit. At the end of the second experiment, students were asked to fill in a survey questionnaire that asked them about their attitude towards Quizitor and the decisions they made when choosing which devices to use for accessing it.

The experiments started with the third lecture of the course and finished with the ninth lecture. During this period, students took an in-class quiz at the beginning of every lecture. These quizzes were assessing students' knowledge of the material presented to them at the previous lecture. After every lecture, students were given access to new at-home quizzes that they could use to practice the material that was just presented to them. During the first experiment, all lectures and in-class quizzes were organized online due to Covid-19 regulations. During the second experiment, the quarantine rules were partially lifted in the middle of the semester, and one in-class quiz was conducted face-to-face in a lecture hall.

The Target Course

Both experiments were organized in the context of the same Web Technology course for undergraduate students. Every year, it is taught from February till April. Table 1 shows the list of topics from this course covered by Quizitor. There are seven topics ranging from HTML to Express JS. Each topic had one in-class quiz and several at-home quizzes. Overall, the at-home quizzes had a larger number of questions than the in-class quizzes. In 2021, 218 questions were prepared, although not all topics were covered by the at-home quizzes. In 2022, we edited the question material; some questions were removed, and many new questions were added to cover the missing topics. The total number of questions was 194.

Collected Data

Two types of data were collected during the experiments: the events in the Quizitor log and students' answers to the survey questions. For each student's login, Quizitor recorded the username, the login time, and the used device profile. Every time students opened a question and answered it, Quizitor recorded the answer, the correctness of the attempt, the attempt submission time, and the current session.

The questionnaire was distributed to students of the second course before the final exam. It consisted of three main parts combining 29 questions. The first part asked about the general behavior of students when using mobile devices for educational purposes in general, and Quizitor in particular. Table 2 shows the set of questions from the first part of the questionnaire.

Table 1.
List of topics and the number of questions

		2021			2022		
No	**Topic**	**Mode**	**In-class**	**At-home**	**Mode**	**In-class**	**At-home**
1	HTML	Online	10	40	Online	10	27
2	CSS	Online	10	40	Online	10	27
3	Basic JavaScript	Online	10	40	Online	10	10
4	DOM	Online	10	20	Online	10	18
5	Advanced JS	Online	10	-	Online	7	19
6	NodeJS	Online	10	-	F2F	6	10
7	ExpressJS/Arrow Function	Online	8	10	Online	10	20
Total			68	150		63	131

The second part of questionnaire was based on the System Usability Scale (SUS) developed by Brooke (1996). It consisted of 10 questions about the user's impressions of using Quizitor. Its questions were five-point Likert-scale questions with options ranging from "strongly agree" to "strongly disagree". The final score a student could obtain on this scale was between 0 and 100. If the score was 70 or above, it meant the target application had an acceptable interface (Bangor et al., 2009). Table 3 shows the items in the SUS.

The last part of the questionnaire asked about students' opinions regarding their interaction with Quizitor. It also included a question asking students to provide suggestions for the improvement of Quizitor in the future. Table 4 shows the set of questions in the last part of the questionnaire.

RESULTS

System Usage

Table 5 presents the numbers summarizing mobile usage of Quizitor over the two experiments. In the first experiment in 2021, there were n=198 students enrolled in the course; 87% of them (n=174) used Quizitor. Of this number, 27% of students used mobile devices at least once. In the second experiment in 2022, there were n=176 students enrolled in the course, and 88% of them (n=155) use Quizitor. Of this number, 43% of students used mobile devices at least once. Thus, in terms of the number of students who accessed Quizitor from mobile devices, there was an increase during the second experiment. However, it only covered a few questions compared to the students who accessed Quizitor from the desktop.

Table 6 summarizes the session length from mobile and desktop based on the number of sessions and the number of questions attempted by students. The session length and the question coverage numbers for in-class quizzes are omitted as it was not students who decided on how many questions a particular session/quiz would take, but the teacher. We also see that the difference in the number of sessions is not large for the in-class quizzes. It is definitely smaller than for the at-home quizzes. In terms of the at-home quizzes, where students could regulate the assessment activity by themselves, they worked less on mobile than on desktop. Students on average logged into Quizitor much more from desktop, and when they logged in, they stayed longer and attempted many more questions overall.

Looking deeper

In this section, we investigate only the data from the second year, as there were just not enough "mobile" events during the first experiment. In order to take a deeper look at the students' choices on whether

Table 2.
Questions on mobile usage preferences

No	Question	Options
1	How many hours per day do you use a mobile phone on average?	
2	How many hours per day do you use it for productive tasks (not news/ entertainment-related browsing, social networking, or gaming)?	
3	Do you ever use a mobile phone for learning-related activities?	Yes No
4	Do you ever use educational apps on your mobile phones?	Yes No
5	What educational apps have you used? - Selected Choice	Kahoot, Blackboard, Mentimeter, Duolingo, Other (…)
6	What is your opinion about the following statement? - I find mobile educational apps effective.	Strongly disagree – Disagree – No strong opinion – Agree – Strongly agree
7	Have you tried in-class Quizitor quizzes on your mobile phone?	Yes No
8	Why did you try in-class Quizitor quizzes on a mobile phone? - Selected Choice	• Convenience of access (QR code was easy to scan), • Convenience of usage (it seemed like an easy and reasonable option), • General habit (I prefer mobile access when it is possible), • Novelty/Interest (I was interested to try a learning tool on my phone), • Other reasons (Please, give us a short explanation)]
9	Have you tried at-home Quizitor quizzes on your mobile phone?	Yes No
10	Why did you try at-home Quizitor quizzes on a mobile phone? - Selected Choice	• Convenience (it seemed like an easy and reasonable option), • Habit (I prefer mobile access when it is possible), • Novelty/interest (I was interested to try a learning tool on Mobile), • Other reasons (Please, give us a short explanation)]
11	Why did you stop using in-class Quizitor quizzes on a mobile phone? - Selected Choice	• Prefer desktop (Desktop version is better for this kind of activity), • Did not like mobile (Mobile version of Quizitor is harder to use), • Redundancy (During an online lecture, I am using my laptop anyways), • Other reasons (Please, give us a short explanation)]
12	Why did you stop using at-home Quizitor quizzes on a mobile phone? - Selected Choice	• Prefer desktop (Desktop version is better for this kind of activity), • Did not like mobile (Mobile version of Quizitor is harder to use), • Did not like the system (I did not enjoy using Quizitor altogether), • Did not like content (I did not like the quizzes and questions available in Quizitor) • Other reasons (Please, give us a short explanation)
13	Would you use the mobile browser version of Quizitor more actively if it had a better interface	Yes Maybe No
14	Would you use the mobile version of Quizitor more actively if it was implemented as a native Android/ iOS app?	Yes Maybe No

to use a mobile or a desktop device to access Quizitor, we can visualize distributions of students in terms of how many Quizitor sessions they have started on different platforms. Figure 3 illustrates these distributions. It is easy to observe that for at-home quizzes ("ah" in Figure 3), only a handful of students

Table 3.
System Usability Scale (SUS)

No	Item
1	I think that I would like to use this system frequently.
2	I found the system unnecessarily complex.
3	I thought the system was easy to use.
4	I think that I would need the support of a technical person to be able to use this system.
5	I found that the various functions in this system were well integrated.
6	I thought there was too much inconsistency in this system.
7	I would imagine that most people would learn to use this system very quickly.
8	I found the system very cumbersome to use.
9	I felt very confident using the system.
10	I needed to learn a lot of things before I could get going with this system

Table 4.
Questions about students' opinions and suggestions

No	Question	Options
1	I think, Quizitor is a useful system overall	Strongly disagree – Disagree – No strong opinion – Agree – Strongly agree
2	I think, Quizitor needs to be used in this course	Strongly disagree – Disagree – No strong opinion – Agree – Strongly agree
3	I think, a mobile version of Quizitor can be potentially useful	Strongly disagree – Disagree – No strong opinion – Agree – Strongly agree
4	Which features Quizitor misses the most in your opinion	• Better quizzes and questions; • Fewer bugs • Better desktop interface • Better mobile interface • Greater variety of question types • Adaptive support for at-home quizzes • Adaptive feedback for in-class quizzes • Quizitor is good as is • The most important features are not listed here
5	If you have any additional comment, please, provide it here	

Table 5.
Comparison of mobile users in 2021 and 2022

No	Items	2021	2022
1	Number of students in the course	198	176
2	Number of students who have accessed the system	174	155
3	Percentage of students who have accessed the system	87.88	88.07
4	Number of students who have accessed from mobile	48	68
5	Percentage of students who have accessed from mobile	27.59	43.87

Table 6.
Average sessions statistics on mobile and desktop devices (2022)

	In-class		At-home	
	Mobile	**Desktop**	**Mobile**	**Desktop**
Session count	2.92 (± 2.28)	3.6 (± 2.73)	1.68 (± 1.17)	8.17 (± 5.13)
Session length			18.55 (± 15.85)	24.35 (± 17.52)
Question coverage			28.24 (± 21.03)	148.84 (± 56.98)

have made any attempts to work with Quizitor on mobile ("ah-m"); most of them have tried it only once. In class ("ic"), the situation is more balanced. Although there were still more students who used desktop ("ic-d"), the "mobile" numbers ("ic-m") are comparable, and the shapes of distributions are similar.

When we look at the number of submitted attempts at questions, the picture is similar, with a strong preference for desktop access at home (see Figure 4).

Figure 5 investigates the dynamics of mobile access, i.e., it visualizes how the number and percentage of students accessing Quizitor on mobile changed as the course was progressing. It is interesting to notice that these data remained stable throughout the semester. For at-home quizzes, this is especially true. As both lines remain roughly horizontal. For the in-class quizzes, the number of mobile students did decrease, yet the percentage remained largely the same. This happened because

Figure 3.
Distribution of students with different numbers of sessions: mobile vs. desktop for the at-home (left) and in-class (right) quizzes

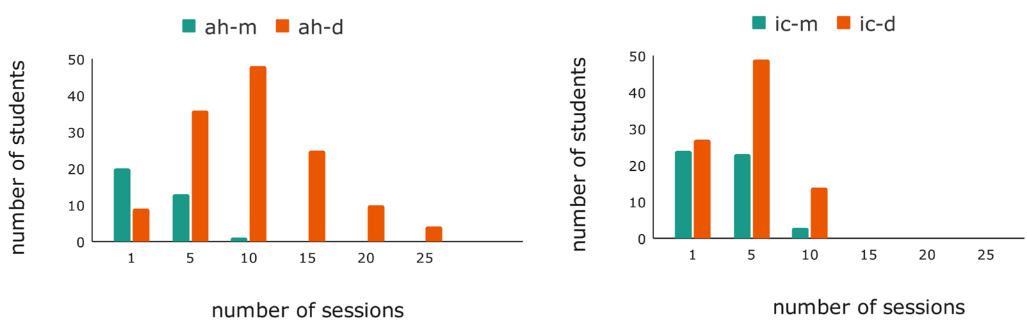
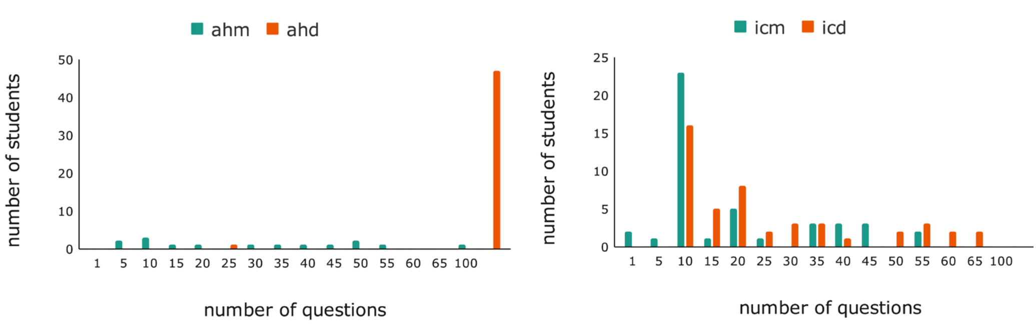


Figure 4.
Distribution of students with different numbers of question attempts: mobile vs. desktop for the at-home (left) and in-class (right) quizzes



the overall number of students attending lectures and taking in-class quizzes lowered with time, and this equally affected desktop and mobile users of Quizitor.

Figure 6 shows the number of daily sessions for mobile and desktop for at-home quizzes. The course starts in February and ends in April. The graph shows a small number of sessions at the beginning of the course. It goes up in the middle, which was the time before the midterm exam was conducted. After that, the sessions decreased again before going up in April before the final exam.

In addition, Figure 7 shows the numbers of sessions for at-home quizzes on mobile and desktop distributed based on the time of day when the sessions happened. Most sessions on both mobile and desktop took place during the first half of the day between 8.00 am to 15.00pm. There is also a slight increase from 17.00pm to 19.00pm.

User Evaluation

In addition to collecting data within Quizitor, we have also administered a short questionnaire at the end of the second experiment. The structure of the questionnaire is described in the section "Collected Data". This section describes the results of this questionnaire. Altogether, 49 students responded. We excluded responses from 11 students who did not use Quizitor actively enough, hence their opinions were not substantiated by experience. Thus, 38 responses were used for analysis. An average student in the course was an active user of mobile devices, spending 3.92 hours on them daily (SD=1.56). About 24% of this time (M=0.96 hours, SD=1.01) was spent on productive tasks. Almost all students reported that they had experience of using their phones for learning related activities and

Figure 5.
Number and percentage of mobile users for at-home (left) and in-class (right) quizzes

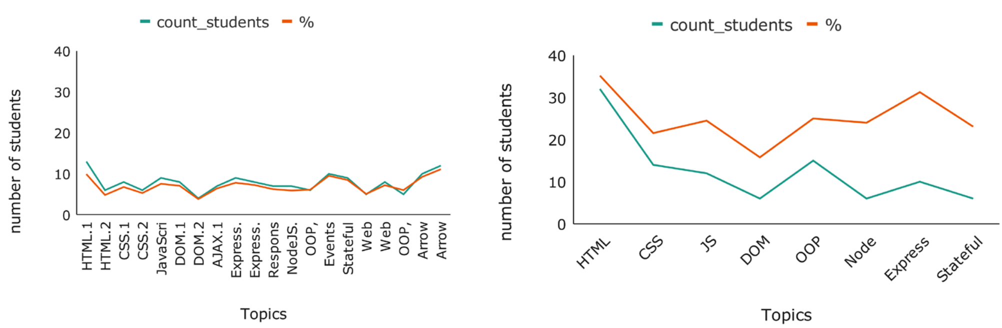
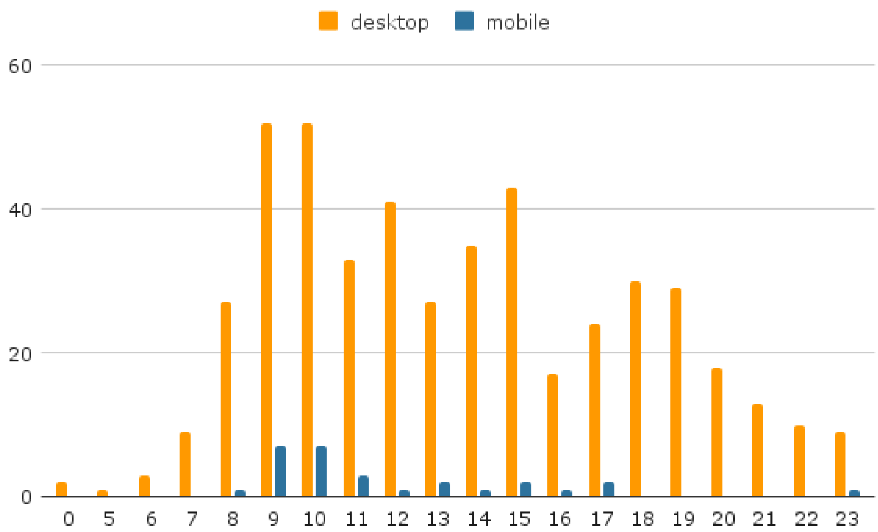


Figure 6.
Mobile and desktop sessions across the days of the semester

Figure 7.
Mobile and desktop sessions between across the hours of the day



for educational apps. Hence, on average, Quizitor users could be characterized as experienced users of m-learning technologies.

System Usability Scale (SUS) is a common scale used to measure the usability of the system after its implementation. Based on this scale, the average usability score for Quizitor is 75.2% (SD=8.9%). According to (Bangor et al., 2009), this score is within the acceptable range. In addition, we also asked students three questions specifically addressing the perceived value and quality of Quizitor, i.e. “I think, Quizitor is a useful system overall”, “I think, Quizitor needs to be used in this course”, “I think, a mobile version of Quizitor can be potentially useful”. Most students agreed or strongly agreed with these statements.

Students’ Feedback reflects the students’ preferences about using the tool. In this section, students were asked about the motivation to use mobile devices for accessing Quizitor and the reasons they might have stopped using it. For in-class quizzes, 21 out of 38 students reported that they used Quizitor at least once on a phone. Their answers about the reasons to “… try in-class Quizitor quizzes on a mobile phone” were distributed as follows. 52% said it was because of the convenience of access (the QR code played a big role here) and the convenience of usage. 10% used a mobile as a habit. 15% used it because of novelty/interest. The remaining 23% used the option “another reason” and listed reasons like “I needed another device to open Quizitor, because I already used my laptop for another activity”, “I used mobile, because it was possible according to the teacher”, “I used a mobile device, because my laptop was running out of battery”. For reasons for stopping using mobile, some students stated they prefer to use desktop (14.2%), and some others stated that using mobile is a redundant task (33%). In addition, even though they have not tried Quizitor on mobile, some students referred to the distracting effects of mobile devices and difficulties in remembering their authentication information to login to Quizitor on mobile.

15 out of 38 students reported that they tried using mobile devices to answer the at-home quizzes. Not all the students explained their reasons. “Convenience” was listed by 33%, “Being able to take a quiz on a train” was given as a reason by 13%. “Using the laptop for another activity” was reported by another 13%. For their reasons for stopping using on mobile, they stated that when using the phone for learning they were easily distracted by notifications and messages. For their reasons for stopping using mobile Quizitor at home, most of students prefer using desktop (60%).

DISCUSSION AND CONCLUSION

Mobile devices have many advantages for supporting various learning activities. This study has focused on the use of mobile devices for accessing an assessment platform. Our original motivation was to use the successful examples of existing mobile systems for self-regulated practice and assessment (such as Duolingo) and group-based on-the-spot assessment/voting (such as Kahoot!) and explore the factors contributing to the success of these tools. We have developed Quizitor – an online platform that can support both mentioned modes of assessment and is accessible on both mobile and desktop devices. For two years, Quizitor was used by students of an undergraduate course on Web Technology. We have not specifically promoted either of these two ways to interact with Quizitor. We have expected that due to affordability, portability, and ease of use, mobile devices will be used more often for in-class assessment. Similarly, we have thought that the mobile version will be popular with students when they engage in self-regulated practice at home.

However, when we put these ideas to the test, the results were quite different from what we expected. Use of mobile devices among students to access Quizitor was quite low. It is very different from the results of some previous studies indicating strong preference among students for mobile learning systems over desktop ones (Bröhl et al., 2018). Our experiments indicated quite the opposite for both in-class quizzes and at-home practice. Fewer students accessed Quizitor on mobile than on desktop, and fewer students explored a variety of course topics using their mobile devices. Students who tried both versions of the interface spent less time on mobile devices, they answered fewer questions, started fewer sessions, and these sessions were shorter. We still have registered mobile traffic on Quizitor, but on any statistics, the desktop version was a clear winner. After the first year, we have added one simple, yet effective feature – we have regularly provided students with a QR code linked to the Quizitor website. This has resulted in an increase in the number of mobile interactions for in-class quizzes, yet mobile usage still remains far lower than desktop usage.

We have looked more closely at our data and the way our system has been used, in addition we have asked the students what they think about Quizitor, its mobile interface, and why they have been choosing the desktop version of the interface over the mobile version. There are several key factors that have dissuaded students from more active usage of mobile Quizitor. When it comes to the in-class mode, an important aspect of both courses is that they were organized during the Covid-19 pandemic. This meant that all lectures were conducted online over the Microsoft Teams environment. Most students followed these lectures using their desktop devices. When a teacher was launching in-class quizzes, students were already using a digital device connected to the class. For many of them, it was easier to open another window and access Quizitor on the same device instead of using a mobile phone just for this task. We believe that once the course moves back to a lecture hall, the use of mobile phones during the in-class quizzes might increase. Another reason is that, for some students, a mobile phone is very distracting, especially with the recent proliferation of messaging apps. Such a potential detrimental effect of mobile devices on learning has been reported in the literature (Hartley et al., 2020).

As fewer students accessed the in-class quizzes on mobile, they were less eager to switch their preferred access platform when they used Quizitor at home. Lower utilization of mobile devices in self-regulated learning activities has been discussed in other studies as well. The causes can be different. For example, a smaller screen, longer loading time, and no specialized apps to use (Fan et al., 2020). Another reason is the lack of student awareness of the advantages of using mobile devices to support learning activities (Yot-Domínguez & Marcelo, 2017). We think that the lack of a dedicated native app might have been another key factor in our case. The example of Duolingo clearly shows that when an interactive desktop browser-based app competes with an interactive native mobile app, the mobile app can win students over. One more step in the right direction for us will be the development of a Quizitor app for Android and iOS platforms. Given that the use of mobile devices follows a stable pattern (see Figure 5), a dedicated mobile app equipped with effective mobile affordances can increase the number of mobile users. For example, notifications can be used as effective nudges to promote a more active use of the system and provide support for self-regulated learning.

When comparing students' access to the at-home quizzes from mobile and desktop devices, one more difference attracted our attention. The length of mobile sessions was significantly lower. This means that even when students decide to engage in self-regulated practice with Quizitor on mobile, they lack guidance, feedback or other types of support that can keep them engaged. One of the directions for future work for us will be implementation of the personalized support that informs students about their progress and guides them to the most relevant questions. It has been successfully demonstrated that such adaptive guidance is an effective tool for motivating students to work with non-mandatory educational content, and, in particular it makes students stay with the system longer, promoting lengthier and more meaningful practice sessions (Brusilovsky et al., 2006).

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Conflict of Interest

The authors of this publication declare no conflict of interest.

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