Evaluating the Usability of a Study Support Mobile App for Higher Education

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ABSTRACT
Mobile learning (m-learning) is increasingly adopted in Higher Education (HE) given that almost all undergraduates own mobile devices with Wi-Fi and fast Internet connections. In HE, undergraduates are required to spend a significant proportion of time on self-study as well as use effective learning strategies during self-study to achieve academic success. Therefore, the use of mobile applications opens a wealth of opportunities for undergraduates to learn by giving them continuous access to learning materials as well as enabling them to study at their own pace. However, undergraduates’ use of mobile applications may be influenced by the applications’ usability. The current study examines the usability of a mobile app developed to support learning in HE to shed light on undergraduates’ experience using a mobile learning application in HE context for self-study and study support. While the results reveal a good level of acceptance in terms of learnability, efficiency, and satisfaction, further findings indicate that the app needs slight improvements in terms of memorability and errors. There are two key outcomes of this study, as a study support tool, the results show that undergraduates may rely on such apps for practicing and testing knowledge rather than using the app as a tool for studying. As a usability study, we did not only examine the memorability, efficiency, user satisfaction, and learnability, but also assisted ourselves in obtaining plentiful suggestions for further improvements of the app based on student experiences.

Author Keywords
evaluation; usability; gamification; self-study; m-learning; usability in education; mobile app

INTRODUCTION
As mobile technologies become more affordable, it is not surprising that many undergraduates own one. In a meta-analysis conducted by Wu, Wu, Chen, Kao, Lin, and Huang (2012), mobile phones and personal digital assistants (PDAs) together accounted for 75% of all mobile devices used in educational contexts. Chen and Denoyelles (2013) reported that more than half of the surveyed undergraduates used their personal smartphones for academic purposes and 20% of the mobile applications installed were for education. Therefore, the current technological practices of undergraduates suggest that incorporating mobile learning (m-learning) into the university curriculum in the form of mobile applications is a promising approach to enhance student learning.

Mobile applications (apps) are software packages that can be installed in mobile devices to provide services to its users and are considered as an important emerging technology in higher education (Wai, Ng, Chiu, Ho, & Lo, 2018). Research studies on mobile apps have examined usage of different types of apps (Bomhold, 2013), compared app usage of undergraduates from different disciplines (Kim, Ilon, & Altmann, 2013), and investigated undergraduates’ adoption of apps for academic purposes. While studies showed that types of apps and study discipline are related to app usage, few studies have examined the usability of apps that is specifically designed for self-study.

Besides evaluating the effects of using mobile apps on learning, we argue that it is also important to examine the usability of mobile apps. The effects of using mobile apps on learning may be dependent on whether students view mobile apps as usable. Therefore, research should consider the extent to which students view mobile apps as usable when evaluating the effects of mobile apps on learning.
In the current research study, we present a usability evaluation of a mobile app, EUR Game App (Zafar, F., Wong, & Khalil, 2018) that includes different modalities to improve student engagement and support active learning during self-study.

The paper provides a general theoretical background in the following introduction subsections. The context of the study, research questions, and the methodology are then introduced in the second and third sections. Results are presented in the fourth section followed by the discussion and conclusion in the last two sections. It is noteworthy that in the context of the paper, we used the terms EUR Game App and game app interchangeably referring to the same mobile application.

**Use of Mobile Application in Higher Education**

Mobile learning (m-learning) refers to learning that is supported by mobile technologies (Cheon et al., 2012). The core educational concepts relating to mobile learning are: 1) access to learning, 2) contextual learning, 3) arranging learning across contexts, 4) personalization, and 5) collaboration (Börner et al., 2010). Also, according to (Cheon et al., 2012), m-learning is able to support students who are progressing at different levels in a class by providing self-paced learning outside the classroom. Moreover, mobile learning would provide learners just in time (JIT) information, which is crucial for complex learning (Van Merriënboer, Clark & De Crock, 2002). Based on these features, m-learning seems very well suited for self-study activities and could possibly be used to support the SRL processes during self-study.

Based on the theory of planned behavior, Cheon et al. (2012) found that students are more likely to use their mobile devices for their coursework when they perceive m-learning as easy to use and useful. Other than the usability of the mobile app functionality, an enjoyable and satisfying experience is also crucial to students’ adoption of m-learning (Nordin, Embi & Yunus, 2010). Therefore, in this current research study, we examined the usability of a mobile app developed at the Erasmus University Rotterdam called EUR Game App to support self-study based on different criteria by Nielsen (1994) and Mun and Hwang (2003).

**Self-Study Support in Higher Education**

Undergraduate courses typically require students to invest a significant proportion of their time on self-study. Undoubtedly, students are more likely to achieve better academic performance when they invest more time in self-study (Masui et al., 2014). Other than the amount of time invested in self-study, Wijnen et al. (2017) argue that the quality of self-study, in terms of the learning strategies employed during self-study, is another important factor that contributes to student success. Effective self-study involves the planning of self-study activities, self-monitoring of one’s learning progress, and self-evaluation of one’s learning performance. Accordingly, self-study entails self-regulated learning (SRL).

SRL refers to the extent to which individuals monitor, control, and regulate their motivation, metacognition, cognition, and behaviour to optimize their learning and performance outcomes (Cleary, Callan, & Zimmerman, 2012). While one line of research shows that SRL strategies are positively correlated to academic outcomes in higher education (Richardson, Abraham & Bond, 2012), another line of research shows that students poorly monitor and regulate their learning due to a poor understanding of how they learn and remember (Bjork, Dunlosky, & Kornell, 2013). For instance, many students assume that re-reading is a more effective strategy than testing, even though research shows that testing leads to better learning performance (Karpicke, Butler, & Roediger, 2009). Therefore, to enhance academic outcomes in higher education, it is critical to support the use of effective SRL strategies, and ultimately, the quality of self-study (Wong et al., 2019).

Self-monitoring is an important component of SRL. Only accurate monitoring processes can provide students with information on which effective regulation choices can be based. Nicol and Macfarlane (2006) explained that “monitoring is a by-product of purposeful engagement in a task” (p.10) because students (to a certain degree) monitor the gap between their self-set goals and the outcomes that they achieve. Unfortunately, without instructional support, students show inaccurate self-monitoring and tend to overestimate their own performance (e.g., Khalil et al., 2018). To help students better judge their progress against their own goals, teachers can provide students with self-monitoring opportunities such as self-testing (Baars, 2014).

Roediger, Putnam, and Smith (2011) identified several benefits of self-testing—the act of testing oneself during study: i) testing aids retrieval of information from memory, and in turn, supports retention of information, ii) testing identifies gaps in knowledge between what is learned and what is not yet learned, iii) testing helps in organization of knowledge, and iv) testing supports self-monitoring. Presumably, self-testing supports self-monitoring because students can actively generate information from the learning materials which enables them to monitor how well they are capable of doing that. This generation effect has been found for learning from text (e.g., Thiede et al., 2009) as well as for learning to solve problems (e.g., Baars, 2014).

In sum, there is a need in higher education to support self-regulation processes such as self-monitoring to improve self-study. Using a generative strategy like self-testing is a promising study strategy to do so.

**USABILITY EVALUATION OF MOBILE APPS**

The number of mobile applications for educational purposes (i.e., support teaching, support learning, administrative, etc.) has expanded in recent years. With such a large variety of applications either developed as responsive applications that fit mobile screens or as complete mobile apps, usability is one of the key factors that judges how successful is an app. The term usability was first coined in the 1980s to test and improve performance of systems (Wei et al. 2015). According to
ISO FDIS 9241-210 (https://www.iso.org/standard/52075.html, last accessed: June 2019), usability is defined as “the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”. In fact, the definition of usability could also overlap with user experience. The latter is defined as “A person's perceptions and responses that result from the use and/or anticipated use of a product, system or service”. Bevan (2009) stated that “... there is no fundamental difference between measures of usability and measures of user experience at a particular point in time, the difference in emphasis between task performance and pleasure leads to different concerns during development” (p. 1). For a possible reason, researchers working in the field consider user experience to be entirely subjective, but usability may involve both subjective and objective measures (Bevan, 2009).

Usability evaluation methods in mobile applications have been various. Maramba, Chatterjee, and Newman (2019) conducted a systematic review study on usability methods used to evaluate mobile apps in eHealth settings. Out of 133 papers, Maramba, Chatterjee, and Newman (2019) found six types of usability testing methods ordered as: 1. Questionnaires, 2. Task completion, 3. Think-aloud, 4. Interviews, 5. heuristic testing, and 6. Focus groups.

In educational context, there are quite few usability evaluation studies such as the usability testing of Q-Ibadah (Saidin et al., 2015), a mobile application designed to help primary school students in Malaysia with religious studies. The outcome of Saidin et al. (2015) study gave the application developers the chance to improve handling of the app and increase its level of satisfaction.

In Wei, Chang, and Cheng (2015) study, usability of a library mobile application was evaluated and tested. Their usability evaluation was based on a 3-tier approach including a pre-test questionnaire, tasks, and post-test survey. The authors looked at evaluating satisfaction, efficiency, and effectiveness of the application. Likewise many usability studies of mobile applications, Wei, Chang and Cheng (2015) came up with a list of recommendations to improve the end user experience. In addition, the researchers realized that their mobile application was not efficient enough. Further, clarity was revealed to be the app’s weakest point.

Another example is the usability evaluation of a mobile learning application at Fiji national university (Kumar & Mohite, 2017). Kumar and Mohite (2017) picked three categories from Nielsen (1994) recommendation list to conduct their research: satisfaction, ease of use, and usefulness. The results highlighted some usability problems, and further recommendations were suggested to enhance the application.

From the above examples, we believe usability studies of mobile applications is crucial to improve learners experience. Usability should be investigated and studied to help, but not limited to:

- Developers in improving applications and enhancing user experience.
- Researchers in carrying out finer research studies without numerous errors.
- Teachers in using innovative ways of teaching without the hassle of bad designs.
- Students in helping them to self-regulate their learner and support their studies and as a consequent improving their performance.

CURRENT STUDY

Context

App design

Two main factors were considered when designing the app to ensure that various content can be offered. First, requirements for a teacher to implement the mobile app were kept as simple as possible to account for the differences in teachers’ level of proficiency in using technology and to increase the level of adoption across courses and faculties. Second, only multiple-choice questions with at least 2 answer options were allowed given that mobile devices have a limited space for the text to fit the screen at one glance.

Teachers’ requirement

The teachers are in full control of the content to be covered in the app. Therefore, teachers can customize the mobile app to align with the topics in class. To set up the app, teachers will place a minimum of 250 questions divided over at least 5 categories that match the topics in the course. Each question contains at least 2 or more answer options including feedback (also on the wrong answers) and a reference to relevant literature, videos, or a prior educational activity. Throughout the course, changes can be made instantly without any effect on the app. The app comes with a teacher-facing dashboard that provides teachers with useful information such as the number of students who completed a question and the percentage of correct answers given to a question.

Student-facing design

The questions formulated by the teachers are divided over four game modalities: practice, test, compete, and battle (see Figure 1). In the first two modalities, the app focuses on individual learning. The practice mode allows student to answer as many questions as they wish. Feedback is shown after each question. In the test mode, students can assess their learning and explore how much of the knowledge is retained. The test mode is recommended after attending a lecture or any other study activity related to the app. By answering questions in sets of 10 per round, students are tested on how well they understand a certain topic. Feedback in this mode is provided after answering a complete set of 10 questions per play round.
In the other two modalities the app focuses on fun experiences to stimulate competition among students. In the compete mode students are challenged to play against the entire student group, within a limited time frame. Students are not provided any feedback and after a wrong answer they are out of the game. They can view their standing on the leaderboard. Teachers who want to challenge the students often offer a prize for the top three students on the leaderboard. This play mode can be used in small groups where groups of students compete in a tutorial.

The battle mode is a multiplayer mode. Students can challenge a random student, a known fellow student or even a teacher. In three rounds, the players go head to head answering question as quick as they can. Delivering correct answers quicker than the opponent adds points leading to a higher ranking on the leaderboard.

Each mode helps students gain insight into their own progress. With the provided feedback, students gain a better understanding of where they are in their learning of a certain topic. The strength of repetition, practicing with old exam questions, and feedback creates a learning loop that contributes to the knowledge level of students.

**Research Questions**

In order to understand how the higher education students perceived the EUR Game app, we identified two research areas: i) the level of usage and experience, and ii) the usability of the game app. The research questions (RQs) are:

**RQ1:** How often did students use the EUR Game app and which mode was used the most for studying in the course?

**RQ2:** What were students’ perceived usability and enjoyment of the EUR Game app?
METHODOLOGY
Survey questions were designed to explore and answer the research questions. Qualtrics (http://qualtrics.com) was used to create and deliver the questionnaire. Since the students’ native language was Dutch, the questionnaire was translated from English to Dutch by one of the authors. An invitation and two reminders to complete the survey were sent to all students.

We have affirmed, to a large extent, that our sample is randomly drawn and is not biased towards a specific population. Further, students’ identifiable variables were not linked to their full names, keeping the questionnaire input anonymised.

Research Design
In order to assess the usability of the studied mobile app, a questionnaire was designed where general questions about which mode (i.e., practice, test, compete, and battle) was mostly used by the students, and a set of questions that are based on five usability criteria from Nielsen (1994) and one criterion on enjoyment from Mun and Hwang (2003). These include:

• Learnability: How easy is the application to learn and start working on.
• Efficiency: How efficient is the system in terms of productivity
• Memorability: How memorable is the application when a user leaves it for a while
• Errors: The application should have a low error profile without catastrophic bugs
• Satisfaction: How pleasant is the application to use and are the users satisfied of its functionalities?
• Enjoyment: Closely related to motivation by which we examine whether students were enjoyed using the application.

A Likert scale questionnaire was provided at the end of the course. The first part of the questionnaire included six Likert scale questions to know the level of usage of the mobile application in general and each mode in particular. The latter scaling was set between 1-7 in which a value of 1 indicates the “Not at all” answer and the value of 7 indicates a “high level of usage”. The second part of the questionnaire included 20 Likert scale questions used with a scaling between 1-7 in which a value of 1 indicates “not at all true” and value of 7 indicates “very true”.

Given the aforementioned six criteria, four questions were orchestrated to evaluate the “learnability” criterion. Three questions were directed to evaluate the “efficiency” criterion. Two questions evaluate the “memorability” and “errors” criteria, respectively. Four questions were orchestrated to evaluate satisfaction, and five questions were directed to measure enjoyment of each mode of the application.

The data analysis method is quantitative based on descriptive statistics such as mean, percentage, and standard deviation. In addition, the internal consistency scale of the answers was validated using the Cronbach’s alpha (\( \alpha \)) on applicable criteria.

RESULTS
Participants Profile
The survey was sent out to approximately 800 full and part time Year 1 Bachelor students in the “Introduction to constitutional and administrative law” course at Erasmus University Rotterdam during the period February to March 2018. Attending the course lectures was optional. The full-time program included nine mandatory tutorial meetings. To fulfil the course requirement, students have to complete skill assignments and take a final exam at the end of the course. The final exam consists of 40 multiple choice questions with a weightage of 60% and open-ended questions with a weightage of 40%. Students had access to the mobile app during the course, and the use of the mobile application for self-study was optional. The overall male to female ratio in the course was 36% to 64% (i.e., 9:16) and the general response rate was 10.12% for the first questionnaire and 8.80% for the second questionnaire.

Questionnaire Results
To answer the first research question, we looked at how often students used the game app. Table I shows the students’ perceived level of usage for each mode of the game app and the purpose of the game app. From these results it is clear that the compete and battle modes were not often used by the students. On the other hand, the practice and test modes lean towards an average usage. A similar picture arises with the use of the game app for studying. Around 50% of the students used it once a week to practice. Likewise, the last item of the questionnaire shows that 60% of the students used the mobile app to test their knowledge of the course material.

With respect to students perceived usability of the EUR Game app, Table II provides an overview of the answers from the six criteria. Learnability, efficiency, satisfaction and enjoyment maintain an acceptable level of internal consistency at levels of Cronbach’s \( \alpha \) greater than .70 and less than .82 indicating a fine coherence of the answers. Cronbach test for memorability and error were excluded because of the few questions in both categories.
Results from the table have shown that the students were satisfied with the app. The average score of the four subitems is as follows:

<table>
<thead>
<tr>
<th>Survey item</th>
<th>Not at all</th>
<th>Seldom</th>
<th>Not often</th>
<th>Sometimes</th>
<th>About once a week</th>
<th>About once per two to three days</th>
<th>About once per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>I used the practice mode</td>
<td>7.40%</td>
<td>11.12%</td>
<td>6.17%</td>
<td>18.51%</td>
<td>22.23%</td>
<td>23.45%</td>
<td>11.12%</td>
</tr>
<tr>
<td>I used the test mode</td>
<td>19.75%</td>
<td>14.81%</td>
<td>12.34%</td>
<td>22.22%</td>
<td>16.05%</td>
<td>8.65%</td>
<td>6.18%</td>
</tr>
<tr>
<td>I used the compete mode</td>
<td>49.39%</td>
<td>11.11%</td>
<td>6.17%</td>
<td>17.28%</td>
<td>2.47%</td>
<td>9.87%</td>
<td>3.71%</td>
</tr>
<tr>
<td>I used the battle mode</td>
<td>60.49%</td>
<td>12.34%</td>
<td>9.87%</td>
<td>8.65%</td>
<td>1.24%</td>
<td>4.94%</td>
<td>2.47%</td>
</tr>
<tr>
<td>I used the EUR Game App to study the materials for this course</td>
<td>13.59%</td>
<td>6.17%</td>
<td>7.40%</td>
<td>19.76%</td>
<td>20.98%</td>
<td>20.98%</td>
<td>11.12%</td>
</tr>
<tr>
<td>I used the application to figure out how well I have learned the information that I am studying (testing knowledge)</td>
<td>8.64%</td>
<td>3.70%</td>
<td>3.71%</td>
<td>16.04%</td>
<td>25.93%</td>
<td>27.16%</td>
<td>14.82%</td>
</tr>
</tbody>
</table>

Table 1. Students’ reported specific level of the EUR Game App usage (N=81)

<table>
<thead>
<tr>
<th>Survey item</th>
<th>α</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Learnability</em></td>
<td>.702</td>
<td>5.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In general, the app was easy to use</td>
<td>.702</td>
<td>5.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It was easy for me to learn how to use the app and navigate through it</td>
<td>.702</td>
<td>5.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I find it easy to understand how the battle mode works</td>
<td>.702</td>
<td>5.59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I find it easy to understand how the compete mode works</td>
<td>.702</td>
<td>5.59</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>.716</th>
<th>5.43</th>
</tr>
</thead>
<tbody>
<tr>
<td>I found the app responsive</td>
<td>.716</td>
<td>5.43</td>
</tr>
<tr>
<td>I was able to use the app without frustration</td>
<td>.716</td>
<td>5.43</td>
</tr>
<tr>
<td>The information provided in the app is sufficient for me to navigate the app easily</td>
<td>.716</td>
<td>5.43</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Memorability</th>
<th>.480</th>
<th>4.31</th>
</tr>
</thead>
<tbody>
<tr>
<td>I remembered how to use the app when I leave it for a while</td>
<td>.480</td>
<td>4.31</td>
</tr>
<tr>
<td>The app was able to recall the same page where I last left</td>
<td>.480</td>
<td>4.31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error</th>
<th>.857</th>
<th>5.26</th>
</tr>
</thead>
<tbody>
<tr>
<td>The app gave error messages when I made a mistake</td>
<td>.857</td>
<td>5.26</td>
</tr>
<tr>
<td>I did not encounter bugs and errors in the app</td>
<td>.857</td>
<td>5.26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Satisfaction</th>
<th>.818</th>
<th>5.75</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was satisfied with the app as a study tool</td>
<td>.818</td>
<td>5.75</td>
</tr>
<tr>
<td>I found the app entertaining for me</td>
<td>.818</td>
<td>5.75</td>
</tr>
<tr>
<td>I found the app user-friendly</td>
<td>.818</td>
<td>5.75</td>
</tr>
<tr>
<td>Overall, I am satisfied with the app</td>
<td>.818</td>
<td>5.75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enjoyment</th>
<th>.707</th>
<th>5.26</th>
</tr>
</thead>
<tbody>
<tr>
<td>I enjoyed using the practice mode of the game app</td>
<td>.707</td>
<td>5.26</td>
</tr>
<tr>
<td>I enjoyed using the test mode of the game app</td>
<td>.707</td>
<td>5.26</td>
</tr>
<tr>
<td>I enjoyed using the compete mode of the game app</td>
<td>.707</td>
<td>5.26</td>
</tr>
<tr>
<td>I enjoyed using the battle mode of the game app</td>
<td>.707</td>
<td>5.26</td>
</tr>
<tr>
<td>I would like to use the game app for future courses</td>
<td>.707</td>
<td>5.26</td>
</tr>
</tbody>
</table>

Table 2. Students’ perceived usability and satisfaction of using the EUR Game App
measuring satisfaction was 5.75, suggesting a positive reception. Likewise, the learnability criterion was close to the average results of satisfaction. Students found that the mobile app was very easy to use and navigate. In terms of efficiency and enjoyment, a mean score of 5.43 and 5.26 out of 7 points were recorded, respectively.

On the contrary, only a score of 4.31 was reported for the memorability criterion. The application sometimes appears to fail recalling the same page when a user returns back to it. The error evaluation reception by the students was slightly above average but still low compared to the other criteria.

**DISCUSSION**

The discussion and conclusions address the research questions.

A. *RQ1: How often did students use the EUR Game app and which mode was used the most for studying in the course?*

Results from Table I showed that students used the mobile app to test their knowledge of the course material rather than considering it as a standalone study tool. When comparing between using the mobile app for studying or testing knowledge purposes (i.e., the last two items in the questionnaire), more than 65% of the students used the application at least once a week, with 42% of twice usage a week towards the latter purpose. The results suggest that students perceived the mobile app as more of a diagnostic tool than a study tool. Such results support the conclusion from Kornel and Son’s (2009) research in which students are using self-test strategies to diagnose their learning rather than using the app as a tool for learning.

With reference to which mode was used most, the questionnaire in Table I shows that more than half of the surveyed students did not use the game modes (i.e., compete and battle) as much as the feedback modalities (i.e., test and practice). Perhaps students preferred modalities by which feedback is given when committing mistakes. As such, direct feedback has a positive influence on gamification and increase users’ commitment to study goals (Locke & Latham, 1990).

B. *RQ2: What were students’ perceived usability and enjoyment of the EUR Game app?*

According to Nielsen’s (1994) criteria, the studied mobile app received a good usability rating. The app can be improved in terms of errors, bugs, and recalling cached pages. The general evaluation results reveal that the functionality with respect to the five criteria provides a stable application as a self-study support tool. Students have enjoyed using the app for its simplicity and helping them to practice. As expected, users are delighted to use the app for future courses. However, the slightly lower rating of Mun and Hwang’s (2003) enjoyment criterion for the compete and battle modes suggests that gamification modalities should be enhanced.

**Limitations**

One limitation is that the conducted surveys were based only on one course. Therefore, it is not clear whether students in other courses would have different usage patterns. Another limitation is that the study is based solely on self-reports. Questions on how students use the app and obstacles were not asked. Future research could combine self-reports with user observations and interviews to better understand other factors that could impede students’ use of the app for self-study. Finally, this evaluation is not based on discussing the computation efficiency of the game app.

**CONCLUSION**

The present study provides a case study of using a mobile app, EUR Game App, as a self-study tool in higher education and the evaluation of its usability. The app received a good usability rating and can be adopted in on-campus classes as a study support tool.

In general, the four modalities of the app were used, but on different levels. Although there were groups of students who were slightly more active than others, teachers’ role in promoting the app in their classes and explaining the benefits of self-testing as a study strategy are highly needed for a more feasible adoption of such an app in higher education settings and for a stronger impact.

With regards to usability, future research is still needed to further explore usability evaluation methods for mobile learning apps. Nevertheless, the research study at hands contributes to the field of user experience and usability evaluation of educational mobile apps and help us to further develop the EUR Game App and improve its efficiency.

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