Functionalities of Mobile Learning Apps and Potential for Data Integration in the Context of Higher Education: A Systematic Review

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1 BACKGROUND

Research Question

What are the core functionalities of mobile learning apps and what kind of data integration takes place with existing infrastructures in higher education?

Functionalities

Mobile devices become more and more advanced each year and new applications and the features within are being constantly developed. For example, due to advances in mobile technology, it is now possible to make use of augmented reality technology [1]. It is important to keep track of the current state of mobile learning (ML) applications to identify new learning opportunities.

Data integration

Mobile applications can collect various useful data that can be later on used on another platforms.

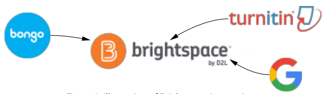

Figure 1: Illustration of Brightspace integrations

Past research already addresses the issue of integrating third-party applications into learning management system (LMS) [2]. However, mobile application environment has changed significantly since then and some of the technologies discussed in that research are already outdated.

2 METHODOLOGY

Method

Qualitative systematic review

Search Strategy

The literature search was conducted by following **PRISMA** principles [3]. All articles were selected from the period of 2015-2021 to analyze how latest technological advancements were applied in educational process.

Sources

IEEE Xplore digital library, Scopus and Google Scholar

3 SEARCH PROCESS

Common Inclusion Criteria	Common Exclusion criteria
Article was peer-reviewed and original	Article was not written in English
Abstract of the article included the search terms	Title of the article did not include any search terms
Inclusion Criteria for Data Integration	**Exclusion Criteria for Data Integration**
Discussed data integration approach was used in higher education	Article proposed a new integration technology or framework that was not publicly available
Inclusion Criteria for Features	**Exclusion Criteria for Features**
Type of the mobile device was limited to smartphones, tablets and wearable electronics (e.g., smartwatches)	Article did not justify the feature's utilization outcome by any measuring instrument (in the context of higher education)

Table 1: Inclusion and exclusion criteria

Search Terms
"mobile learning", "mlearning", "interoperability", "data integration", "application(s)", "higher education", "functionalities", "features", "learning management system", "LMS", "app(s)", "mobile devices", "mobile application(s)", **"adaptive learning", "push notifications", "gamification", "collaborative learning", "personalization", "augmented reality", "artificial intelligence", "chatbot", "LTI", "API"**

Table 2: Search terms

ANALYSIS FRAMEWORK

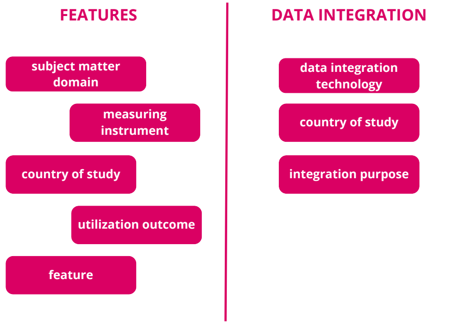

Figure 2: Analysis framework

4 FINDINGS

FEATURES

Features discussed in non-academic context

Push notifications [4]

Studies [10,11,12] show that push notifications are an appropriate mechanism for capturing user's engagement and increasing interaction with the application

Artificial Intelligence [5]

One study [13] showed how interaction between the users and a chatbot for learning gave positive results

Personalization [6]

One study [14] expressed the need for personalizing learning content

Features discussed in the context of higher education (HE)

Collaborative learning [7]

Gamification [8]

Augmented reality [9]

Studies from six different countries show the overall positive effect of utilizing apps with such features. Furthermore, each application gave new learning opportunities, such as:

- leaving live notes on recorded lectures [15]
- viewing the human body in AR [16]
- competing in online quizzes [17]

Learning experience could be described as:

fun, engaging, effective

DATA INTEGRATION

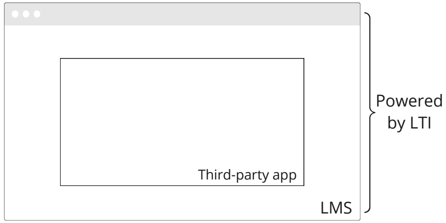

Figure 3: Illustration of LTI being used for the integration

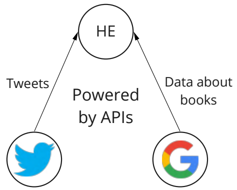

Figure 4: Illustration of integrating data with APIs

5 CONCLUSIONS

- Positive usage experience of the applications having collaborative learning, gamification, or augmented reality in the context of higher education
- Positive usage outcomes were reported in different countries and academic disciplines
- No literature was found regarding the applicability of AI, personalization and push notifications in the context of HE. However, some studies show them being practical instruments for increasing engagement or learning motivation
- Confirmed use cases of LTI for integrating whole applications and APIs for extracting data

6 FUTURE WORK

- Identifying core features by using a different metric
- Analyzing applicability of push notifications, personalization and AI in the academic context
- Analyzing API's applicability in higher education. Conducting case studies by using ML apps' APIs for integrating students' data - such as grades, submissions, and more
- Revisiting the research question once again in the future due to the constant developments in mobile technology

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