

## PAPER

# Privacy Protection in Learning Management Systems' Mobile Technology-Based Learning Analytics

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## ABSTRACT

Mobile technology use in education is changing, much like in the business and health sectors. Research is now conducted on designing user-centric platforms that allow people to engage in teaching and learning activities. Although the learning management systems (LMS) field supports students and academic endeavors, the application's high requirements prevent it from having the desired effect. More significantly, although mobile applications are convenient, there is a chance that user data could be maliciously exploited and eavesdropped. Due to the communication overhead of sending raw data to the central learning processor, wireless application structures cannot adapt to the original structure of mobile learning, which calls for data and processing heads to have a centralized entity. The goal is to offer fresh viewpoints and approaches that bring educational assessment up to date. This project aims to give educators scientifically based assessment tools and tactics by thoroughly examining the use of mobile technology in academic assessment. This will allow for more accurate teaching management and individualized instruction.

## KEYWORDS

learning management systems (LMS), mobile technology, education, academic endeavors

## 1 INTRODUCTION

A popular information technology that many educational institutions worldwide are implementing to raise the standard of instruction is the learning management system (LMS). In contrast to traditional learning settings, current LMS provide learners a gamified environment that is more dynamic and engaging, allowing them to finish courses while enjoying the learning process. Students can manage, communicate, and evaluate their class schedule [1], assignments, tests, and interactions with classmates with the use of LMS. Using an LMS, the instructor can save time by sending out messages, resources, and tests to students. They therefore have plenty of opportunity to encourage pupils to think and understand more deeply, particularly

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in light of the COVID-19 epidemic, for example. The majority of LMSs available now offer a mobile version that makes using them on mobile devices easier. Thus, it can be concluded that LMS are the most crucial platforms for mobile learning, or m-learning, which is more affordable, interesting, and available than conventional teaching techniques. Additionally, lifelong learning is greatly aided by mobile learning platforms and applications such as LMS. To thrive in the cutthroat world of today, everyone must embrace lifelong learning.

Studies on students' intentions to use mobile educational management systems are scarce, despite the fact that they give college students a way to evaluate course material using their mobile devices. Giving students access to an m-MLS does not ensure that they would utilize it on a daily basis. It's possible that students view the system differently. For example, before they began utilizing the system, several pupils were unaware of its potential benefits [2]. As far as we are aware, no empirical research has been done on the use of m-LMS by Swedish university students. Thus, it makes sense to investigate this growing trend. Sweden has a high rate of mobile phone penetration and one of the best Internet infrastructures in the world. With a strong wireless network infrastructure, Swedish university students can readily access a wide range of mobile services.

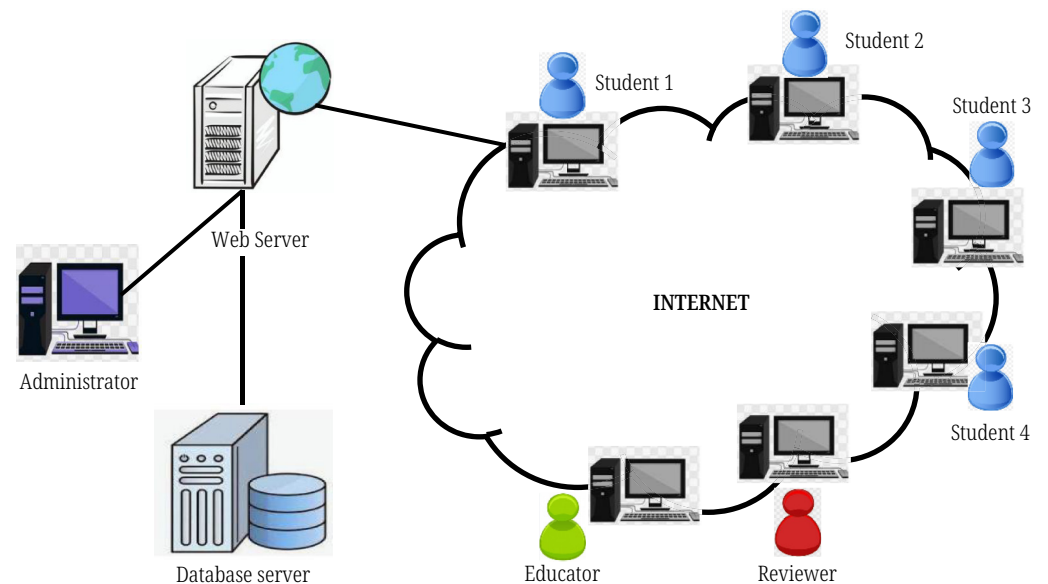


Fig. 1. Learning management system

The LMS process is depicted in this picture. The LMS's primary function is to give enrolled students access to formal education via the internet, including various course materials, documents, presentations, and videos. The LMS functioned as a virtual classroom that allowed for interactions between students and the classroom as well as between students and their peers, teachers, and reviewers. The presentation of learning objects, interaction facilitation, collaborative learning, and timely feedback are the four main tenets of online learning best practices that are supported by the LMS's core services. The LMS administrator oversees the system's administration as well as additional administrative tasks, including instructors, reviewers, and students. Developing course materials for students in the system is the responsibility of the instructor. While the reviewer is in charge of verifying and checking the various video lessons that the students have searched, the student is in charge of handling assignments and assessments.

Since m-learning is a relatively young field, a lot of study and effort is now being done. People are specifically attempting to comprehend:

- Which learning models can be used to improve learning processes when mobile devices are used to mediate communication, and how does a student's mobility impacts their learning process?
- How, considering the physical constraints of mobile devices, learning processes based on these technologies might be assessed for efficacy and efficiency.
- Which mobile device-friendly services are available, and which enabling technology has the potential to influence the widespread adoption of mobile learning?

The term "mobile learning educational process" refers to any teaching and learning activity that can be carried out using mobile tools or in environments where mobile equipment is accessible. We will provide an overview of some of the lines that national and international research in the field of m-learning is focused on. Any device can refer to a particular kind of m-learning because of the various devices that are already on the market as well as those that are soon to be released, each of which has unique constraints and innovations that inspire diverse approaches to using them for learning. A number of the unresolved issues pertain to the usage of mobile devices in education. Numerous studies have been conducted to examine the pedagogical and cognitive components of m-learning since the word first surfaced.

The rest of the paper is structured as follows: In Section 2, Related Work is displayed. The research methodology is described in Section 3. This section has more sub-sections. The quality of the paper is assessed, the exclusion criteria are stated in Section 4, the data is extracted, and the results are formulated using the data synthesis method, and Section 5 carefully reviews the responses to the research questions and validity challenges before delivering the conclusion.

## 2 RELATED WORKS

A person's behavioral intention (BI) is described as their goal to use a certain technology to accomplish a variety of tasks. BI is defined as the degree of dedication an individual exhibits to a particular behavior, in this case the degree of dedication exhibited by students to accept the usage of LMS in order to achieve the learning objectives of their courses. Numerous academics have examined how BI affects technology's real-world usage patterns and discovered a strong and clear correlation [4]. The emphasis of this component has changed from physical to virtual as social networking sites and information technology have developed. In both required and optional contexts, researchers have discovered a direct correlation between SI and people's BI in regard to technology use. According to a global survey, social influence had a favorably significant and comparatively greater impact on BI in Korean respondents than in US respondents.

Mobile learning is anticipated to be important in a variety of educational contexts because of its many advantages (such as affordability, accessibility, location-based services, and the ability to serve as a study aid) [5]. Above all, mobile technology has enormous potential to provide students with a wide range of resources and immersive multimedia experiences, allowing them to learn in both official and informal educational settings without being constrained by time or place. Thus, for students enrolled in e-learning courses, educational institutions that specialize in open and distance learning have tried to create applications such as mobile LMS.

Given the steadily rising demand from students, online educational institutions should prioritize the quick deployment of such systems.

As mobile learning develops, new applications have emerged, such as the current LMS, which is known as a mobile LMS and can be accessed via mobile devices. No matter the time or place, instructors and students can access courses on their cell phones with the help of the m-LMS, a type of mobile learning technology [6]. Studies on students' intentions to use mobile educational management systems are scarce, despite the fact that they give college students a way to evaluate course material using their mobile devices. Giving students access to an m-MLS does not ensure that they would utilize it on a daily basis. It's possible that students view the system differently. For example, before they began utilizing the system, several pupils were unaware of its potential benefits.

According to the theory of situated learning, learning can be improved by making sure it occurs in a real-world setting [7]. For the simple reason that they can be used in a variety of circumstances to improve the learning activity, mobile devices are particularly well-suited for context-aware apps. Context-aware mobile computing has been pioneered by the museum and gallery industry, which offers more details on exhibits and displays according to the visitor's position inside them. Conversation theory, which characterizes learning in terms of exchanges between various knowledge systems, is another theory that is especially pertinent to our examination of collaboration utilizing mobile devices even though it is not typically associated with collaborative learning. Collaborative learning facilitated by mobile computers can be supported by mobile devices.

Researchers and educators are paying more attention to mobile devices in learning contexts. Government-funded initiatives are being promoted in an increasing number of nations to urge schools to include mobile technology in their normal curriculum. Numerous noteworthy discoveries have demonstrated the advantages of mobile learning, including the ability to give students immediate feedback, enhance peers' negotiating abilities, increase learning effectiveness, and connect classroom and real-world learning [8]. Despite the fact that various studies have reviewed the subject of mobile learning, they typically suggested new concerns and trends over the time period they covered. But it's also critical to comprehend the research areas and effects of carrying out studies on mobile learning. However, not much study has been done to examine the traits of the widely referenced publications in the mobile learning space.

To assess the effects, uses, and difficulties of mobile learning, the authors gathered and contrasted research. According to the study, mobile learning enhanced authentic learning, encouraged reflective practice, promoted educational environments, improved student participation and engagement, and allowed for distance communication. The study's goal was to give educators and researchers a better understanding of research difficulties and subjects. The study identified a number of themes and research areas that can be investigated in higher education mobile learning [9]. The investigation provided an overview of the objectives, methods, topic, educational setting, educational level, geographic distribution, and device kinds of papers published between 2010 and 2016.

The term "mobile learning systems/resources" describes the software, system, or materials created and/or utilized for language learning on the go. There are seven coding items in this dimension: proprietary apps or systems [10], free applications (apps) or systems, researcher-developed mobile systems, Internet sources, Not specified, mixed/vary, and without the usage of resources or systems. "Mixed/varied" describes the use of multiple learning system/resource types in the study, whereas

“No use of systems or resources” indicates that no learning systems or resources were purposefully utilized.

### 3 METHODS AND MATERIALS

#### 3.1 Mobile education

An extension of e-learning, mobile learning enables users to complete their coursework using wireless, compact devices. Applications for mobile learning are being created to offer online education in a portable setting. It gives students the chance to learn whenever and wherever it is most convenient for them. It is not necessary for teaching and learning to take place at a certain place or time [11]; rather, it is flexible and can happen at any moment. Since mobile technology is both obvious and inevitable, educational institutions all over the world have begun incorporating it into their teaching and learning processes.

Although mobile phones have made educational resources more accessible due to their lower cost and greater flexibility, there are drawbacks as well as advantages.

Among the advantages are:

- a) No geographical restrictions because learning can take place at anytime and anywhere;
- b) Assistance in the development of a self-centered learning pedagogy by students; and
- c) The facilitation of an effective learning communication mechanism that allows instructors and students to endorse and review the content.

Among the difficulties are the following:

- a) Mobile learning separates students who are technically proficient from those who are not;
- b) It is heavily reliant on a network resource platform; and
- c) It may cause a sense of alienation between students and teachers.

The majority of writers now writing on the topic have a general vision of mobile learning, which aims to enable learning that can allow participants to communicate, collaborate, and be creative in real and suitable contexts of use at any time and from any location. This is seen in some ways as a revolution in the transmission of information that is just-for-me and just-in-time.

#### 3.2 Classroom management: activities and techniques that encourage learning

Globally, “the actions teachers take to create an environment that supports and facilitates both academic and social-emotional learning” is the standard definition of classroom management (CM) as a topic of study. Therefore, CM is a tool for establishing and preserving the best possible learning environment in light of the targeted academic curriculum as well as social and emotional competencies. A continuum between the opposing ideas of intrinsic motivation and motivation can be used to illustrate motivation, which is thought to be the driving force behind all actions

and behaviors. This shows that some extrinsic motivations are associated with intrinsic motivation, while others are associated with motivation [12]. The heart of CM is thus defined as promoting motivation and basic psychological requirements.

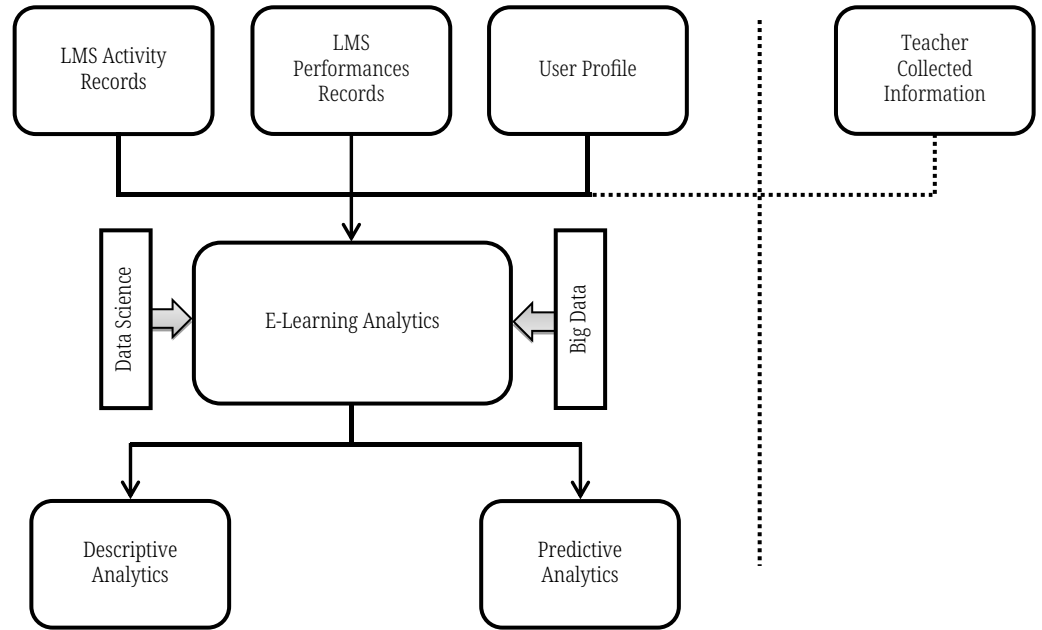


Fig. 2. The conceptual framework of the research

**The advantages of distance education.** When necessary, mobile learning gadgets may connect to the internet because they are portable. If internet access is available, a distance student can take advantage of such technology without interfering with their travels. Therefore, having an internet connection is essential while utilizing a mobile learning device. In addition to users who are constantly on the go, students who are disadvantaged or disabled can also benefit from this technology in order to overcome the distance, which prevents them from attending regular classes and contributes to poverty because students who live far away are unable to travel to regular classes that the state offers. Additionally [13], impaired students can use their mobile devices to learn and interact with others without having to worry about getting hurt or disturbed by leaving their safe havens.

As the head of mobile-based activities, a user plans, organizes, executes, and assesses his learning while utilizing m-learning technology. Therefore, rather than being a passive recipient of the necessary information, the learner employs cognitive and metacognitive skills to complete the job. Thus, the user enhances their capacity for higher-order thinking.

**Mobile learning’s difficulties.** Technological determinism is the first issue facing mobile learning and other technologies. Technology has a significant role in how society is evolving, but it is not the only driver. Technology is merely one of many changing aspects that contribute to social developments. Putting technology, and specifically mobile learning technology, at the heart of classes produces the desired results for the benefit of the users. Therefore, m-learning technology is merely a tool that could lead to more significant ways of teaching and learning remotely.

Creating m-learning applications is another undertaking that requires expertise and tactics. How well the learners succeed depends on whether the current system is modified to make the m-learning tools more useful or how the context is converted into technology. A lot of thought and planning must go into integrating pedagogy,

technology, and context according to each person's characteristics. The following [14] essential guidelines should be followed by a system designer when creating mobile learning: cost, system usability, technology selection, roles, equipment management, teacher assistance, administration, collaborative services or applications, and security concerns.

## 4 IMPLEMENTATION AND EXPERIMENTAL RESULTS

### 4.1 Discussion and findings from the educational pilot

With 73 students in the sample for the educational context setting, the Mann-Whitney U and Student's T tests might be used. The Mann-Whitney U test findings were comparable for both tests. The Student's T-test results are displayed in Table 1. The DV column contains the standard deviation for the experimental and control groups (S<sub>XE</sub> and S<sub>XC</sub>), the contrast variable (t), the bilateral signification, and the average value for the experimental and control groups (X<sub>E</sub> and X<sub>C</sub>). Each row corresponds to an item or statement identified by its id.

With 73 students in the sample for the educational context setting, the Mann-Whitney U and Student's T tests might be used. The Mann-Whitney U test findings were comparable for both tests [15]. The Student's T-test results are displayed in Table 1.

**Table 1.** Findings from the educational area student's T-test

DV	X <sub>E</sub>	S <sub>XE</sub>	X <sub>C</sub>	Sx <sub>t</sub>	t	ρ
<b>T-Test Pre-Test Results</b>						
12.	4.34	2.088	4.12	2.007	1.840	1.407
13.	4.34	2.173	4.04	2.211	1.980	1.334
14.	5.74	1.552	5.59	1.541	2.149	1.227
<b>T-Test Pre-Test Results</b>						
15.	4.43	2.056	3.82	2.134	3.141	1.038
16.	4.79	2.068	4.22	1.962	3.280	1.028
17.	5.35	1.997	3.59	2.120	7.335	1.002

**Table 2.** Findings from the educational sector's Mann-Whitney U-test

DV	R <sub>E</sub>	R <sub>C</sub>	U	Signification
<b>Result of the Mann-Whitney U Test (Pre-Test)</b>				
12.	42.29	36.18	469	1.236
13.	41.34	36.59	491	1.367
14.	42.36	36.15	466.6	1.170
<b>Result of the Mann-Whitney U Test (Pre-Test)</b>				
15.	46.12	34.52	381.6	1.027
16.	46.82	34.23	368.6	1.015
17.	57.41	29.66	135.6	1.001

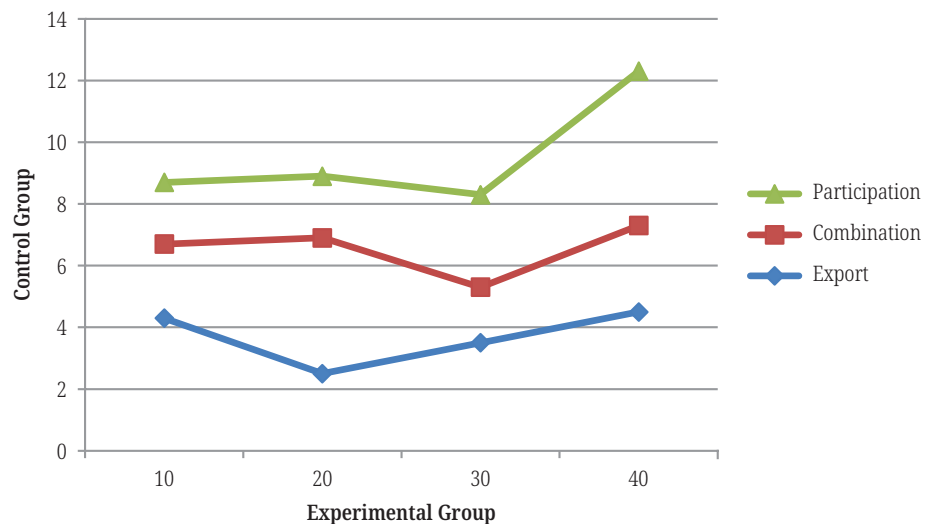
These values show that the students in the experimental group and the control group use the tools similarly with respect to the I1, I2, and I3 assertions. This is due to the fact that each item’s bilateral signification is more than 0.05, indicating that both groups see using Moodle forums in an academic setting similarly. It should be mentioned that the average values for the need to use learning resources other than those offered by the LMS are extremely high for both the experimental and control groups. That combination may be conceivable because of the framework, even though Moodle does not support it. These findings are supported by the Mann-Whitney U-test results (refer to Table 2).

**Table 3.** Findings from the text analysis that categorized the material according to the specified units

	Export	Combination	Participation	Problems
Teacher 1	Correct	Positive	Can be increased, other Contexts	Loss of Attention
Teacher 2	Useful	Positive	Increases, Combination	Too much Contexts
Teacher 3	Necessary	Positive	–	No Problems
Teacher 4	Acceptable	Useful	Indifferent	Different networks, how to provide feedback

Both qualitative and quantitative methods were applied to the teachers’ opinions. Table 3 displays the findings.

The majority of teachers have a favorable opinion on functionality export, which they consider to be beneficial, according to Table 3. Additionally, they believe that students’ usage of these technologies in conjunction with other learning resources is beneficial and enhances their education (see Figure 3). The ability to use the tools in other contexts that are more tailored to their needs and where all of the learning resources they use are available within the same framework may also increase participation, though some teachers felt this was irrelevant because participation is required in their context.



**Fig. 3.** For both the experimental and control groups, the LMS is incredibly high

**Table 4.** Findings for the technological area Mann-Whitney U-test

DV	R <sub>e</sub>	R <sub>t</sub>	U	Signification
<b>Result of the Mann-Whitney U Test (Pre-Test)</b>				
12.	19.23	13.55	41.52	1.094
13.	18.45	15.22	67.02	1.818
14.	14.66	15.15	69.52	1.873
<b>Result of the Mann-Whitney U Test (Post-Test)</b>				
15.	22.31	12.47	20.02	1.006
16.	18.81	13.81	45.02	1.118
17.	21.45	12.77	26.02	1.011

Table 4 makes it evident that the range values for the pre-test with significance levels over 0.05 are extremely similar for the experimental and control groups. This suggests that both groups view using Moodle forums for educational purposes in a similar way.

**Table 5.** Findings from the technical area instructors' text analysis, which grouped the content according to the specified units

	Export	Combination	Participation	Problems
Teacher 1	Interesting	Evolution	Indifferent	Less Attention
Teacher 2	Useful	Improvement		Content and activity quality is not Assured
Teacher 3	Correct	Innovation	Increases	None
Teacher 4	Indifferent	Positive		Non-institutional tools

It is clear from Table 5 that the majority of teachers think exporting features is beneficial. They also believe that when students use these tools in conjunction with others, learning platforms will evolve more easily, and students will learn better since they will have more resources to assist their learning activities.

## 5 CONCLUSION

Researchers have become more interested in LMS in recent years because they engage a diverse group of learning technology users, which should facilitate the process of knowledge acquisition and transfer. But before integrating human life, it's important to see if new technologies such as LMS can adapt and be embraced by potential consumers. Researchers in the literature agree that the technology acceptance model is a good way to find the elements that influence users' perceptions of how to adapt and accept new technology in this situation.

It has been suggested to use a service-based framework approach to implement such capability export. This framework makes it easier for these two settings to communicate with one another by using web services and interoperability standards. Because of this, students can easily define their own PLE and only need to visit the LMS for a small number of crucial tasks. Conversely, this framework offers

educators a wider range of resources for learning objectives and the creation of fresh activities, as well as more details on what the students do in the outside world. It is feasible to conclude from the pilot research that findings regarding the perceptions of both teachers and students indicate that exporting features from institutional settings to different contexts makes it easier to customize learning environments, which in turn enhances student learning. Students with varying technological backgrounds were used to validate this finding in both educational and technology environments. Furthermore, it is feasible to draw the conclusion that PLEs allow for learning personalization, as demonstrated by the controlled environments of the pilot studies, given that the majority of students in these two fields accessed learning resources other than those offered by their institutions. It is advised that future research conduct pilots in various settings, using students from various educational backgrounds and levels, in order to bolster these findings.

Lastly, it should be emphasized that LMSs can be made open, which allows them to develop further and is thought to have the potential to significantly improve student learning in technical and educational contexts.

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