

Investigating Students' Perceptions of Moodle LMS In Terms of Its Features and Usability

Layla Hasan

Software Engineering Department, Zarqa University, Jordan

Abstract *This research investigates students' perceptions of Moodle LMS in terms of its features and usability on both desktop and mobile interfaces. The results present six features of Moodle frequently used by the students and 18 other features which are required by students but which are not provided by the local instance of Moodle used by the university where the study took place. The results also reveal 17 usability problems on Moodle's interfaces. Finally, the results present ten improvements to Moodle suggested by the students to make it more usable from their point of view. The results of this research provide empirical evidences regarding the usefulness of Moodle in terms of its inclusion of features which are required by the students. The results of this research provide useful guidance for academic institutions and universities in general who employ Moodle or other LMSs in terms of considering students' requirements when deciding features to provide in Moodle.*

Keywords: Moodle, Learning Management Systems, LMS, Usability, Students' Perception

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1. Introduction

Continuous advancements in information technology are significantly affecting all the aspects of life, including education. As a result, e-learning, which is an approach that uses computer and communication technologies to facilitate and enhance learning, has become common in academic institutions and universities. E-learning is usually based on Learning Management Systems (LMSs); these are also called course management systems or virtual learning environments [5, 11, 14]. Simonson [20] defined LMSs as: "Software systems designed to assist in the management of educational courses for students, especially by helping teachers and learners with course administration". Academic institutions and universities have adopted and use various LMSs, either to support their traditional face-to-face classroom sessions or to provide distance education [16, 20]. LMSs are either commercial software or free open source software. Examples of common commercial LMSs include Blackboard and WebCT. These systems are very powerful but they demand high licence fees [13]. Alternatively, a popular open source LMS is Moodle, which is used widely in academic institutions and universities. Moodle was developed from a social constructivist perspective by Martin Dougmias in Australia. Moodle has proved to be a serious competitor to other commercial popular LMS software and it is usually the first choice when a low-cost and robust e-learning solution is needed [9]. Moodle has various features which meet the needs of teachers, students or administrators.

The following summarises the core features of Moodle [15]:

- *General features:* easy to navigate interface on both desktop and mobile devices; personalised dashboard to facilitate organising and displaying courses; collaborative tools and activities to support interacting with other students and/ or the teacher; Moodle's calendar tool which helps to keep track of academic or company calendar, course deadlines, group meetings, and other personal events; convenient file management; simple and intuitive text editor; notifications which is used to send automatic alerts on new assignments and deadlines; forum posts and also send private messages to one another; track progress which help educators and learners to track progress and completion for tracking individual activities or resources and at course level.
- *Administrative features:* customisable site design and layout; secure authentication and mass enrolment options to add and enroll users to Moodle site and courses; multilingual capability which allows users to view course content and learn in their own language; bulk course creation and easy backup and restore large courses; addressing security concerns by defining roles to specify and manage user access; simple plug-ins management which enable the administrator to install and disable plug-ins within a single admin interface; regular security updates; detailed reporting and logs which generate reports on activity and participation at course and site level.

- **Course development and management features:** support design and manage courses to meet various requirements; encourage collaboration; embed external resources; multimedia integration; group management; marking workflow (assign different markers to assignments, manage grade moderation and control when marks are released to individual learners); in-line marking (easily review and provide in-line feedback); peer and self assessment using built-in activities such as workshops and surveys; competency based marking; security and privacy.

Despite the large number of useful features which are provided by Moodle, some universities and/or academic institutions, which use Moodle, are not taking the advantages of them. The install and use of Moodle's features is usually under the control of the management and administrators of the universities and/or the institutions. Also, some universities and/or academic institutions which use Moodle and customise its interface, ignore to take into consideration usability issues and users' need. Usability is: "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [8]. Despite the increasing use of Moodle LMS in academic institutions and universities, there is a lack of research which investigates students' perceptions of Moodle in terms of its features and usability on desktop and mobile interfaces. Specifically, there is a lack of research which investigates both features of Moodle which are commonly used by the students, and features which are not provided (or not installed) on the local instance of Moodle but which are required by students. Also, there is a lack of research which investigates detailed usability problems on Moodle interfaces from the students' point of view.

2. Aims and Objectives

The aim of this research is to investigate students' perceptions of Moodle Learning Management System (LMS) in terms of its features and usability on both desktop/laptop and mobile/tablet interfaces.

The specific objectives of the research are:

1. To evaluate the features and usability of Moodle LMS from the viewpoint of students;
2. Based on objective 1, to determine the common features that are supported by Moodle, and the percentage of students who identify each feature;
3. Based on objective 1, to determine the common features that are required by the students but which are not provided or not installed on the local instance of Moodle, and the percentage of students who identify each feature;
4. Based on objective 1, to determine the common usability problems on Moodle's various interfaces,

and the percentage of students who identify each problem;

5. Based on objective 1, to present suggestions for improving the usability of Moodle's interfaces from the viewpoint of students, together with the percentage of students who identify each suggestion.

3. Literature Review

Earlier research, which investigated users' experience with Moodle or evaluated the usability of Moodle, employed either user-based evaluation methods or evaluator-based methods. The user-based evaluation methods included methods which involved users, and aimed to collect data on users' satisfaction with an interface (e.g. via questionnaires) or users' performance while interacting with the interface (e.g. user testing) [7]. Alternatively, evaluator-based methods included methods which involved evaluators in the process of evaluating and identifying usability problems on an interface (e.g. the heuristic evaluation method, pluralistic walkthroughs) [7]. Research has indicated that user-based evaluation methods are mostly used in testing the usability of learning systems [9]. This was confirmed when reviewing earlier research as most of the earlier studies which evaluated the usability of Moodle and investigated users' satisfaction with its interface employed user-based evaluation methods [2, 3, 4, 10, 12, 17, 19, and 21].

For example, Senol *et al.* [19] used questionnaires to evaluate the usability of Moodle, which was adopted by Kocaeli University in Turkey, from the perceptions of 413 students. The results showed that Moodle was not easy to use for the first time and the students were not satisfied with the aesthetic features of the interface, such as the choice of colours. However, only few students indicated that Moodle pages were slow.

Thuseethan *et al.*'s study [21] also used questionnaires to evaluate the usability of Moodle, which was used in seven different universities in Sri Lanka, from students' perspective. The results showed that most of the students liked the Moodle system and found it easy to use. However, the results showed that Moodle had some weaknesses related to: inconsistency problems (e.g. font size and colours), the complexity of using the system to log in and to send assignments, the lack of help included in the system, the lack of error prevention and recovery, and faults in the internal search function.

Al-Sarrayrih *et al.*'s study [2] used questionnaires as well to evaluate Moodle which was used at the Berlin Institute of Technology. The results showed that most of the students (73%) agreed that Moodle had all the functions and capabilities that they expected it to have. The results also showed that most of the students (82%) agreed that Moodle was easy to use. However, the results showed that the students were not satisfied

with the reliability of Moodle; only 46% of the students agreed that they could recover easily when they made mistakes.

Rosato *et al.* [17] also employed questionnaires to evaluate the usability of three learning management systems: WebCT, Sakai and Moodle, from the perspective of students who used the systems for the first time. The results showed the students were satisfied the most with WebCT, while they were satisfied the least with Moodle. The results presented examples regarding various usability problems that the students identified on the systems. These included: posting a discussion message in Moodle and WebCT, reviewing content in all the systems, and submitting an assignment in Moodle.

Furthermore, El-Bahsh and Daoud [6] employed questionnaires to evaluate the effectiveness of Moodle used in the German Jordanian University. The results showed that the students used Moodle LMS to: download course materials, download assignments, take quizzes, and read course news. However, the results showed that the other interactive learning tools supported by Moodle such as: chats, wikis, feedbacks, etc. were not effectively utilized by the students.

Alternatively, Almarabeh *et al.* [1] investigated the challenges faced by the students of The University of Jordan while using Moodle LMS. The results showed that the students faced obstacles while interacting with Moodle such as: hardware resources, defects in the university network, lack of support and help while using Moodle. Almarabeh *et al.* [1] stressed the importance of increasing the awareness of the importance and usefulness of Moodle.

Yadav and Dsilva [22] also employed questionnaires to investigate students' experience with Moodle in Tata Institute of Social Sciences, Mumbai. The results showed that the students were not aware of the various functions supported by Moodle LMS. Yadav and Dsilva [22] recommended increasing the awareness of the usefulness of Moodle.

Alternatively, Baytiyeh's study [3] used online questionnaires to investigate users' perceptions and use of Moodle. However, the participants in her study were not only students from the American University of Beirut, Lebanon (as in the studies mentioned above) but professors from the same university also participated in her study. Unlike the above studies, the results showed that professors and students had positive experiences with Moodle. No weaknesses regarding the use of Moodle were mentioned in her study. For example, the results showed that the majority of the professors and students believed that Moodle was easy to use; it improved the communication between students and professors, and it provided students with prompt feedback from professors. The results obtained by Baytiyeh's study [3] regarding the positive experience of Moodle by the professors and students are not surprising as the

professors and students attended a workshop related to using Moodle before participating in the study, as indicated by the researcher.

Similarly, Ivanović *et al.* [10] employed questionnaires to investigate students' and teachers' perspectives of Moodle in two universities in Serbia and Slovenia. The results showed that both the students and teachers were highly satisfied with Moodle. However, the students provided suggestions to improve the quality of the teaching materials on Moodle including: presenting additional exercises with different difficulty levels; presenting examples of previous exams; and adding more tests and assignments for students. Also, the students suggested using their own local language for Moodle's interface instead of the English language interface.

Rather than employing questionnaires to evaluate the usability of Moodle, Melton [13], using Japanese graduate students, employed the user testing method to evaluate the usability of registering for Moodle and uploading an assignment in Moodle. The English language user interface of Moodle was used during the test. The results showed that the users did not face usability problems which prevented them from registering for Moodle as they were successful in the registration task. However, the results showed that half of the students faced difficulties while submitting an assignment to Moodle. Also, the students indicated that the use of the English language interface, instead of a Japanese interface, made the tasks difficult for them. This corresponds with Ivanović *et al.*'s [10] research which stressed the importance of changing the interface of Moodle to be in the students' own language rather than using the English language interface.

Alternatively, Martin *et al.* [12] employed the heuristic evaluation method to evaluate the usability of three main learning management systems, including Moodle, from experts' points of view. The results showed that Moodle had a strength regarding its ability to help users recognise, diagnose and recover from errors. However, the results showed that Moodle had weaknesses regarding flexibility and efficiency of use.

However, Kakasevski *et al.*'s study [11] employed both the heuristic evaluation method and user testing methods to evaluate the usability of Moodle from the perspectives of students and teachers. The results showed the students and teachers were satisfied with Moodle. They also showed that the students and teachers were more familiar with using the user interface in their own local language (Macedonian) instead of the English language interface. This is similar to the two studies presented above [10, 13]. Furthermore, the results showed that the students and teachers faced usability problems in the assignment and online chat features of Moodle.

The studies above evaluated the usability of the Moodle learning management system from various

users' perspectives when using a desktop interface. However, few studies were found in the literature which evaluated the usability of Moodle on both desktop and mobile interfaces. To the knowledge of the researcher, only two studies were found which addressed this and therefore evaluated the usability of Moodle on desktop and mobile interfaces. For example, Minović *et al.*'s study [14] evaluated the usability of Moodle on both desktop and mobile phone platforms using the think aloud and questionnaire methods. A total of 12 students participated in the study. The results showed that Moodle was not intuitive and user friendly. The students faced difficulties in performing the easiest tasks on Moodle using both desktop platform and mobile devices. However, the number of errors using the mobile devices was higher compared to those on a desktop platform. The results proved that using Moodle via mobile devices was inadequate.

Alternatively, Ssekakubo *et al.* [18] employed questionnaires to investigate students' expectations and experience with various devices used for accessing two learning managements systems: Sakai and Moodle. The devices included desktops, laptops, tablets and mobiles. A total of 144 students from two universities in South Africa participated in the study. The results showed that the LMS services most desired and most accessed by the students included: assignments, announcements, resources, course outlines and the chat room. The results showed also that mobile phones were the least used devices for accessing the LMS devices (9%), mainly due to the inadequate design of LMSs for mobile interaction (e.g. they are slow to open some pages). The authors indicated that mobile phones had usability and compatibility problems when accessing web sites which are designed for desktop or laptop computers. However, no examples of usability problems were presented in either of the studies of Minović *et al.* [14] or Ssekakubo *et al.* [18].

The literature showed that, despite the fact that Moodle LMS is employed widely in various universities in various countries, it still has usability problems which need to be considered when employing it. The literature also showed that there is a lack of research which uncovers weak aspects of Moodle which need to be improved from the point view of students. These weaknesses involve features that are not supported or not installed on the local instance of Moodle used by universities and/or academic institutions, and the presence of detailed usability problems on various interfaces of Moodle (desktop/laptop and mobile/tablet).

4. Methodology

Undergraduate students from different departments at the Faculty of Information Technology at one of the universities in Jordan participated in this research. A

total of 80 students registered in two courses related to human computer interaction and software testing were asked to take part. The students who participated in this study were given extra marks. However, their participation was voluntary. The version of Moodle LMS used by the university was 2.9. However, several plug-ins updates were installed to update it by the administrator in the university. A questionnaire was designed which aimed to gather data from the students regarding their experience with Moodle while using both desktop/laptop devices and mobile/tablet devices. It involved two sections: Section 1 involved closed-questions which were designed to gather students' background information, Internet experience and Moodle experience. Section 2, however, involved four open-ended questions which were designed to gather students' perceptions of the existing and suggested features of Moodle, the usability problems of Moodle on various interfaces, and suggestions to improve the usability of Moodle. The four open-ended questions were:

1. List the features which you are using in Moodle.
2. List the features which you like to use in Moodle but which are not supported by it.
3. List the weak design features in Moodle which prevent you from interacting with it successfully?
4. Suggest improvements to the design of Moodle to make it more usable.

A pilot test was conducted before uploading the designed questionnaire to Moodle to test the questionnaire and to discover and refine ambiguous questions. Before conducting the pilot study, the questionnaire was translated into Arabic. The questionnaire was pilot tested using two undergraduate students from the same university and faculty where the study was conducted. The pilot study identified ambiguity in the questionnaire. Results from the pilot test were taken into consideration and changes were made to the questionnaire

The questionnaire was uploaded to Moodle as homework for the students who had registered for the two courses (human computer interaction and software testing). The deadline was within two weeks and the students were asked to submit their answers to the questionnaire to Moodle. The students who used only desktop/laptop devices to access Moodle were asked to answer the questions in Section 2 (four open-ended questions) once, while the students who used both desktop/laptop devices and mobile/tablet devices to access Moodle were asked to answer them twice to gather data regarding their experience with Moodle using the various interfaces.

Data obtained from the questionnaires were translated into English from Arabic. The data were analysed to uncover students' experience and preferences with the features and design of Moodle. Descriptive analysis was used for Section 1 of the

questionnaire to describe the characteristics of the students and their experience regarding the Internet and Moodle. The students' characteristics are presented in the Results Section. The analysis of the answers to each of the four open-ended questions in Section 2 followed the same procedure. For example, the answers to the second question that were collected from the first student were examined and classified. Then, the answers to the same question that were collected from the second student were also examined and classified and compared to the classification suggested by the answers of the first student. If a match was found, a count of the same answer was calculated. If no match was found, a new classification was generated. This process was repeated for the answers to the second question from all the students. By the end, the answers suggested themes (categories) and the number and percentage of students whose answers suggested each theme were identified. The themes that related to the answers to each question which highlighted the important findings are presented in the Results Section.

5. Results

This section presents the results obtained from the analysis of the questionnaires. It involves two subsections. Section 1 presents the students' characteristics, which were obtained from the analysis of Section 1 of the designed questionnaire while Section 2 presents the students' perceptions of Moodle in terms of its features and usability; this was obtained from the analysis of Section 2 of the designed questionnaire.

5.1. Students' Characteristics

A total of 74 students out of the 80 (92.5%) participated in the study and uploaded answers to the questionnaire; 29 of them answered Section 2 of the questionnaire twice and expressed their experience with the Moodle while using both desktop/laptop devices and mobile/tablet devices. The majority of the students were in the age range of 18 to 22 years. Most of the students (70%) were male while females represented 30% of the participants. Regarding their specialisations, the results showed that more than half of the students were from the Software Engineering Department (65%). Students from other departments also participated, specifically from: Computer Science (16%); Computer Information Systems (12%) and Internet Technology (7%). The students who participated were also in their second (18%) third (52%) and fourth (30%) years of study. The majority (92%) had more than three years' experience using the Internet, and all the students used the Internet daily. Concerning the students' experience with Moodle, the majority (82%) had more than three semesters'

experience using Moodle, and the majority (72%) used Moodle daily.

5.2 Students' Perceptions of Moodle

This section presents the results obtained from analysing the data that were collected from the students concerning their perceptions of the features and usability of Moodle on both desktop/ laptop devices and mobile/tablet interfaces. It includes four subsections; these are mapped to the four open-ended questions listed in the designed questionnaire. Each subsection presents students' answers to one of the four open-ended questions.

5.2.1. Features Supported by Moodle

The results showed that the students used six common features that are supported by Moodle when using either desktop/laptop devices or mobile/tablet devices, as shown in Table 1.

Table 1. Features Supported by Moodle, and the Percentages of Students who Used them.

No.	Features Supported by Moodle	Desktop/ Laptop Devices	Mobile / Tablet Devices
		% of Students	% of Students
1	Downloading materials and learning resources, which included: course outlines, presentations, books, assignments	92.2%	92.7%
2	Uploading assignments	69.5%	70.9%
3	Following-up attendances and absences for the registered courses	42.6%	41.8%
4	Communicating with the teachers using messages	58.9%	63.6%
5	Displaying grades and feedback/comments on the submitted assignments	21.3%	30.9%
6	Evaluating the faculty members/teachers at the end of every semester	17.7%	36.4%

However, the results showed that three out of the six features were the most frequently used on both desktop/laptop devices and mobile/tablet devices. These related to:

1. Downloading materials and learning resources, which included: course outlines, presentations, books and assignments
2. Uploading assignments
3. Communicating with the teachers using messages

Additionally, the results showed that three out of the six features were the least frequently used features of Moodle. These related to:

1. Following-up attendances and absences for the registered courses

2. Displaying grades and feedback/comments on the submitted assignments
3. Evaluating the faculty members/teachers at the end of every semester.

5.2.2. Features not Supported by the local Instance of Moodle

The results showed, however, that the students were dissatisfied with Moodle because it did not support a large number of features (18), compared to the small number of features it does support and which are used by the students (6). The 18 identified features comprised 15 features that were identified commonly on the desktop/laptop and mobile/tablet interfaces of Moodle. The other three features were identified uniquely on its desktop/laptop interface. However, it is important to explain that the 18 identified features did not present a fault or mistake of Moodle LMS. These features are in fact features that are supported by Moodle LMS but the administrator of the university, where the study took place, did not install and use. It is more accurate to consider these 18 features as features that were required by the students but were not provided by the administrator of the local instance of Moodle in the university where the study took place. The 18 identified features suggest three major categories which related to communication, presentation and interaction. Table 2 shows the 18 required features, after being categorised into the three identified categories, that were not provided by the local instance of Moodle, together with the number and percentages of the students who identified them. The following sections present the results:

- **Communication:** The results showed that two out of the three identified features that related to the communication category were suggested commonly by a large number of students on the two interfaces of Moodle (C1, C3):
 - Group chat between students and teachers for the registered courses.
 - Communication among students; e.g. allowing them to send messages to each other.

However, the results showed that one of the features (C2), which related to "Online meeting with teachers who teach the registered courses" was identified only by a small number of students who used Moodle only via a desktop/laptop interface.

- **Presentation:** The results showed that six out of the nine identified features that related to the presentation category were suggested commonly by a large number of students on the two interfaces of Moodle: P1, P2, P5, P6, P7, P9:

Table 2. Features not Supported by the Local Instance of Moodle, and the Percentages of Students who Suggested them.

No.	Features not Supported by Moodle	Desktop/ Laptop Devices	Mobile / Tablet Devices
		% of Students	% of Students
Communication			
C1	Group chat between students and teachers for the registered courses	56.7%	76.4%
C2	Online meeting with teachers who teach the registered courses	14.2%	0.0%
C3	Communication among students; e.g. allowing them to send messages to each other	51.8%	63.6%
Presentation			
P1	Displaying the material and learning resources (course outlines, presentations, books) of the courses before registration	60.3%	72.7%
P2	Displaying previous exam questions or information about the nature of the course exams	63.8%	78.2%
P3	Displaying recorded videos of lectures given by the course teachers	16.3%	0.0%
P4	Displaying courses registered by other students	10.6%	0.0%
P5	Displaying the dates for the first, second and final exams	63.8%	85.5%
P6	Displaying the marks for the first, second and final exams	63.8%	85.5%
P7	Displaying the study plans (outlines) for all the courses	51.8%	60.0%
P8	Displaying monthly evaluation for students in each course and providing comments for them regarding their progress on the course	42.6%	36.4%
P9	Displaying Department advertisements, news and university news	57.4%	67.3%
Interaction			
I1	Providing the user with feedback after carrying out any action during his/her interaction with the system	17.7%	27.3%
I2	Allowing the students to provide suggestions or comments or feedback	42.6%	45.5%
I3	Allowing the students to make changes to the uploaded assignment such as update/ delete	68.8%	83.6%
I4	Sending an alert (e.g. a message to the students' mobiles or emails) when a teacher uploads new material or an assignment	66.7%	87.3%
I5	Sending a reminder to students regarding submitting a required assignment or material before their deadline	58.9%	78.2%
I6	Supplying support and help to students	23.4%	30.9%

- Displaying the material and learning resources (course outlines, presentations, books) of the courses before registration.
- Displaying previous exam questions or information about the nature of the course exams.
- Displaying the dates for the first, second and final exams.
- Displaying the marks for the first, second and final exams.
- Displaying the study plans (outlines) for all the courses.
- Displaying Department advertisements, news and university news.

However, the results showed that two features, P3 and P4, were suggested only by a small number of students who used Moodle via a desktop/laptop interface:

- Displaying recorded videos of lectures given by the course teachers.
- Displaying courses registered by other students.

Finally, the results showed that one feature, P8, which related to: "Displaying monthly evaluation for students in each course and providing comments for them regarding their progress on the course" was suggested commonly by fewer than half of the students on the two interfaces of Moodle.

- **Interaction:** The results showed that three out of the six identified features related to the interaction category were suggested commonly by a large number of students on the two interfaces of Moodle: I3, I4, I5:
 - Allowing the students to make changes to uploaded assignments, such as update/ delete.
 - Sending an alert (e.g. a message to the students' mobiles or emails) when a teacher uploads new material or an assignment.
 - Sending a reminder to students regarding submitting a required assignment or material before their deadline.

Alternatively, the results showed that the three features, I1, I2, I6, were suggested commonly by fewer than half of the students on the two interfaces of Moodle:

- Providing the user with feedback after carrying out any action during his/her interaction with the system.
- Allowing the students to provide suggestions or comments or feedback.
- Supplying support or help to students.

5.2.3. Usability Problems in Moodle

The results also showed that the students were dissatisfied with the design of Moodle. They identified a total of 17 weak design features relating to the interface of Moodle which prevented them from interacting with the interface successfully. The 17 usability problems consisted of: 11 usability problems that were commonly identified on the desktop/laptop and mobile/tablet interfaces of Moodle; four usability problems that were identified uniquely on the desktop/laptop interface of Moodle; and two usability problems that were identified uniquely on the mobile/tablet interface of Moodle. However, it is important to mention that 16 out of the 17 identified usability problems are usability problems that are specific to the interfaces of the local instance of Moodle used by the university where study took place. These problems related to the design of the interfaces of the local instance of Moodle which was customised by the developer and/or the administrator in the university where the study took place. The 17 usability problems suggested four major categories which related to: design; links; content; and ease of use, speed and the internal search function. Table 3 shows the 17 usability problems that were identified, together with the number and percentages of students who identified them. The following sections present the identified usability problems:

- **Design:** The students identified two common usability problems related to the design of the two interfaces of Moodle, D1 and D2, which related to:
 - Inconsistency in the language of the interface. Part of the content of the pages is displayed using the Arabic language and the other part is displayed using English.
 - Inconsistency in the colours of the design.

However, the results showed that the number of students who identified the inconsistency problem which related to the language of the two interfaces was higher than the number of students who identified the inconsistency problem regarding the colour of the two interfaces.

Additionally, the results showed that the students identified two design usability problems uniquely on the desktop/laptop interface of Moodle (D3, D4). These related to:

- Inappropriate choice of colours.
- Unaesthetic design of the pages.

Finally, the students identified one usability problem, D5, uniquely on the mobile/tablet interface of Moodle. This related to: "Inappropriate choice of font size; small font size".

Table 3. Usability Problems in Moodle, and the Percentages of Students who Identified them.

No.	Usability Problems	Desktop/ Laptop Devices	Mobile / Tablet Devices
		% of Students	% of Students
Design			
D1	Inconsistency in the language of the interface	54.6%	76.4%
D2	Inconsistency in the colours of the design	14.2%	27.3%
D3	Inappropriate choice of colours	10.6%	0.0%
D4	Unaesthetic design of the pages	21.3%	0.0%
D5	Inappropriate choice of font size; small font size	0.0%	63.6%
Links			
L1	Links were not working	21.3%	0.0%
L2	Moodle link on the home page of the university is not obvious	60.3%	81.8%
L3	The location of the login links on the home page of Moodle is not obvious	58.2%	72.7%
Content			
C1	Inappropriate content: the home page	61.7%	87.3%
C2	Moodle pages don't have links to the registration page or to the home page of the university	51.8%	47.3%
C3	On the navigation menu, the courses are displayed by their numbers and not by their names which is confusing and not clear	63.8%	81.8%
C4	The titles of the courses are displayed only in the Arabic language, even though there are a lot of foreign (non-Arab) students	28.4%	0.0%
C5	The student can display the titles of all courses in all faculties but he/she cannot access any of them	53.9%	49.1%
Ease of use, speed and internal search function			
E1	Not easy to submit an assignment	78.0%	90.9%
E2	Slow downloading of Moodle's pages	24.8%	76.4%
E3	The location of the internal search function is inappropriate	66.0%	92.7%
E4	Not easy to use and to read since the size of the screen is small	0.0%	96.4%

All the identified design usability problems are specific to the interfaces of the local instance of Moodle LMS that was used by the university where the study took place.

- **Links:** The results showed that two out of the three usability problems relating to links (L2, L3) were identified commonly on the two interfaces of Moodle by a large number of students. These related to:

- The Moodle link on the home page of the university website was not obvious; it was located at the bottom of the page in a small font size.
- The location of the login links on the home page of Moodle was not obvious: one was located at the top of the home page of Moodle but it was written using small font size; the other was located in the middle of the page instead of at the top.

However, the results showed that the students identified another usability problem which related to links uniquely on the desktop/laptop interface of Moodle: L1. This related to: "Links were not working: there is a large number of links not working. When clicking on them, they did not open the supposed destination page. They stayed on the same page".

The three identified link usability problems are specific to the interfaces of the local instance of Moodle LMS that was used by the university where the study took place.

- **Content:** The results showed that students identified five usability problems related to the content of Moodle's pages. Four of them, C1, C2, C3 and C5, were identified commonly on the two interfaces of Moodle. These related to:

- Inappropriate content: the home page of Moodle displayed unnecessary content (e.g. information about e-learning applications). Figure 1 shows the home page of Moodle where the middle displays unnecessary content.

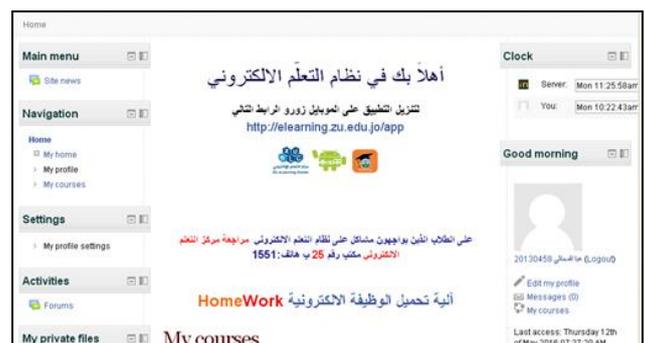


Figure 1. The home page of Moodle where the middle of the page displays unnecessary content.

- Moodle pages don't have links to the registration page or to the home page of the university.
- On the navigation menu, the courses are displayed by their numbers and not by their names which is confusing and not clear. This is shown in Figure 2.



Figure 2. The courses on the navigation menu are displayed by their numbers and not by their names.

- The student can view the titles of all courses in all faculties but he/she cannot access any of them.

However, the results showed that the students identified another content usability problem on the desktop/laptop interface of Moodle: C4. This related to: “The titles of the courses were displayed only in the Arabic language, even though there are a lot of foreign (non-Arab) students”.

All the identified content usability problems are specific to the interfaces of the local instance of Moodle LMS that was used by the university where the study took place.

- **Ease of use, speed and internal search function:** The results showed that the students commonly identified three usability problems related to this category on the two interfaces of Moodle: E1, E2, E3. These related to:
 - Not easy to submit an assignment.
 - Slow downloading of Moodle’s pages.
 - The location of the internal search function is inappropriate; it is located at the bottom of the page and not at the top as expected.

As shown in Table 4, a large number of students identified two out of these three problems on the two interfaces, E1 and E3. However, regarding the slow downloading of Moodle’s pages, the students were more dissatisfied with this usability problem on the mobile/tablet interface of Moodle compared to the desktop/laptop interface.

Also, the results showed that the students identified another usability problem (E4) related to this category only on the mobile/tablet interface of Moodle. This related to: “Not easy to use and to read since the size of the screen is small”.

Only one of the four identified usability problems related to this area is a general problem in Moodle LMS. This is related to: not easy to submit an assignment. The other three usability problems related to this area are specific to the interfaces of the local instance of Moodle LMS that was used by the university where the study took place.

5.2.4. Suggested Improvements to the Design of Moodle

This section presents ten improvements to the design of Moodle suggested by the students to make it more usable. The ten suggested improvements comprised: six common improvements that were suggested concerning the two interfaces of Moodle (desktop/laptop and mobile/tablet), three unique improvements that were suggested to the desktop/laptop interface of Moodle, and one unique improvement that was suggested to the mobile/tablet interface of Moodle. The ten suggested improvements fell into two major categories: design; and links, contents and ease of use. Table 4 shows the ten suggested improvements, presented in the two major categories, that were identified, together with the number and percentages of the students who identified them. The following sections explain the suggested improvements:

- **Design:** The results showed that a large number of students suggested changing the two interfaces of Moodle (desktop/laptop and mobile/tablet) to support the Arabic language, as shown in Table 4, row SD1. Also, the students suggested other two improvements related to the design of the two interfaces of Moodle, SD3 and SD4, which relate to:
 - Changing the colours used in Moodle’s pages to make them consistent.
 - Changing the colours of the design, such as using the blue colour, for example.

Additionally, the students suggested two improvements uniquely for the desktop/laptop interface of Moodle, SD2, SD5, which related to:

- Improving the design of Moodle’s pages.
- Changing the font size used for the website (increasing the font size).

Finally, the results showed that the students suggested changing the design of the mobile/tablet interface of Moodle so that the size of the pages would be adjusted automatically according to the size of the mobile screen (free screen size).

- **Links, content and ease of use:** The results showed that a large number of students suggested the following improvement to the two interfaces of Moodle (desktop/laptop and mobile/tablet): Make the link to open Moodle more visible: e.g. make the link at the top of the home page and use a larger font size.

However, the results showed that the students suggested other two improvements to the interface of Moodle, but these improvements were suggested for the mobile/tablet interface of Moodle

rather than the desktop/laptop interface. These related to:

- Improving the speed of downloading Moodle's pages.
- Making Moodle easier to use.

Finally, the results showed that the students suggested adding a link to the library system to the desktop/laptop interface of Moodle.

Table 4. Suggested Improvements to the Design of Moodle, and the Percentages of Students who Suggested them

No.	Usability Problems	Desktop/ Laptop Devices	Mobile / Tablet Devices
		% of Students	% of Students
Design			
D1	Inconsistency in the language of the interface	54.6%	76.4%
D2	Inconsistency in the colours of the design	14.2%	27.3%
D3	Inappropriate choice of colours	10.6%	0.0%
D4	Unaesthetic design of the pages	21.3%	0.0%
D5	Inappropriate choice of font size; small font size	0.0%	63.6%
Links			
L1	Links were not working	21.3%	0.0%
L2	Moodle link on the home page of the university is not obvious	60.3%	81.8%
L3	The location of the login links on the home page of Moodle is not obvious	58.2%	72.7%
Content			
C1	Inappropriate content: the home page	61.7%	87.3%
C2	Moodle pages don't have links to the registration page or to the home page of the university	51.8%	47.3%
C3	On the navigation menu, the courses are displayed by their numbers and not by their names which is confusing and not clear	63.8%	81.8%
C4	The titles of the courses are displayed only in the Arabic language, even though there are a lot of foreign (non-Arab) students	28.4%	0.0%
C5	The student can display the titles of all courses in all faculties but he/she cannot access any of them	53.9%	49.1%
Ease of use, speed and internal search function			
E1	Not easy to submit an assignment	78.0%	90.9%
E2	Slow downloading of Moodle's pages	24.8%	76.4%
E3	The location of the internal search function is inappropriate	66.0%	92.7%
E4	Not easy to use and to read since the size of the screen is small	0.0%	96.4%

6. Discussion

The results of this research proved the usefulness of Moodle concerning its features; in which it includes all the features which are required by the students. The results of this research showed that all the required features suggested by the students are already features that are supported by Moodle but were not enabled by the university's administrator where the study took place. These results are comparable with earlier research which also showed that most of the features provided by Moodle LMS were not used by the universities which employed it [1, 6, 22]. Also, the results of this research provided evidence regarding the ignorance of considering usability while customising the interfaces of the local instance of Moodle by the university's administrator.

The results of this research which identified the most frequently used features of Moodle are comparable with earlier research which also showed that the most frequently used features related to download materials and learning resources and upload assignments [6]. However this research identified other Moodle's features which were used by the students and showed the number and percentages of students who used each feature.

A comparison between the results of this study and earlier research which evaluated the usability of Moodle showed that there were similarities in terms of five usability problems that were found on Moodle's interface. The five similar usability problems were:

- Not easy to use [1, 14, 19].
- Inappropriate choice of colours [19].
- Slow downloading of Moodle's pages [18, 19].
- Inconsistency problems (e.g. font size and colours) [21].
- Difficulty in submitting assignments [11, 13, 17, 21].

However, this research, by calculating the number and percentages of students who identified each usability problem, showed that four out of the five usability problems were serious for the students as large number identified them. Specifically, a large number of students identified two of these problems on the two interfaces of Moodle: the difficulty in submitting an assignment problem and the inconsistency in the language of the interface as part of the content of the pages is displayed using the Arabic language while the other part is displayed in English. The slow downloading of Moodle's pages problem was identified on the two interfaces of Moodle, but the number of students who identified it on the mobile/tablet interface of Moodle was larger compared to number of students who identified it on the desktop/laptop interface. Finally, the observation that Moodle was not easy to use and to read its content was

identified by a large number of students only on the mobile/tablet interface of Moodle.

Furthermore, this research identified uniquely other eleven usability problems on Moodle's interfaces, as explained in Section 5.2.3; most of these were identified by a large number of students. The identified usability problems, except the difficulty in submitting assignment, are local usability problems related to the local instance of Moodle. The difficulty in submitting assignment, however, is a general usability problem. The identified usability problems should be fixed by the administrator of the university to improve the overall usability of Moodle from the viewpoint of students to encourage them to work on Moodle and to enjoy their experience while working with it.

Additionally, a comparison between the results of this research and earlier studies which investigated users' perceptions of Moodle showed that there were also similarities between their findings and the findings of this research with regard to suggestions to improve Moodle from the viewpoint of students. Specifically, earlier research suggested:

- To improve the quality of the teaching materials on Moodle by presenting additional exercises with different difficulty levels; presenting examples of previous exams; and adding more tests and assignments for students [10].
- To use the local language for Moodle's interface instead of the English interface [10, 11, 13].

However, the students in this research provided nine suggestions to improve the quality of the teaching materials on Moodle, including the suggestions provided by earlier research. These are presented in Section 5.2.2. Also, the results of this research showed that the students suggested uniquely another nine features which they required to be supported by Moodle. Section 5.2.2 explained the required features and the number and percentages of students who suggested them on the two interfaces of Moodle. All the suggested features are already features that are supported by Moodle. These findings are very important for consideration specifically for the university where the study took place and for other universities and/or institutions as they disabled important features which the students require. This reduces the importance of using Moodle LMS and also affects the reputation of Moodle. Almost all of the students thought that the required features were not supported by Moodle LMS while they were not enabled by the administrator of the university. Enabling the required features in Moodle LMS is important to take the advantages of the useful features provided by Moodle LMS.

Regarding the use of the local language for Moodle, a suggestion which was identified in earlier research, the results of this research showed that this requirement was one of the suggested improvements to

the design of Moodle. This was identified by a large number of students on the two interfaces of Moodle, as shown in Section 5.2.4. This research also uniquely identified another nine suggestions to improve the usability of Moodle from the viewpoint of students, as presented in Section 5.2.4.

The identified students' requirements of additional features to be supported by Moodle, and the identified detailed usability problems on the various interfaces of Moodle (desktop/laptop and mobile/tablet), together with the suggestions to improve the design of Moodle's interfaces from the viewpoint of students, could be used to support future design changes in the university where the study took place to produce a more effective Moodle LMS for students.

This research, however, has three limitations. The first is related to the fact that only students participated in this research and reflected their perception of Moodle LMS. Other users such as academic staff and administrative staff were not considered. The second limitation is related to the fact that this research employed only one user testing method, which was questionnaire, to identify the usability problems on Moodle's interfaces. Other usability methods, such as user testing, were not employed. The third limitation is concerned with the selection of only one case study (one Jordanian university) to conduct this research. The perception of students in other universities was not considered.

7. Conclusion

This research investigated students' perceptions of Moodle LMS in terms of its features and usability, taking into consideration two interfaces of Moodle: desktop/laptop and mobile/tablet. Specifically, this research uncovered four important findings which related to: features supported by Moodle and which were used frequently by the students; features supported by Moodle and required by the students but which were not installed on the local instance of Moodle used by university where the study took place; detailed usability problems on the local instance of Moodle; and suggestions to improve the usability of Moodle's interfaces. The results showed that the students used six common features that are supported by Moodle using either desktop/laptop or mobile/tablet interfaces. The results also showed that the students identified 18 features required for inclusion by them which were not enabled on the local instance of Moodle used by the university where the study took place. Furthermore, the results presented 17 detailed usability problems that were identified locally on Moodle's interfaces. Finally, the results showed that the students suggested ten improvements to improve the usability of Moodle's interfaces.

The results are particularly useful for designers, developers, evaluators and managers of Moodle LMSs

in general, and more specifically to the university where the study took place. It is recommended for universities and/or academic institutions which use Moodle to take advantage of the various and wide number of features supported by Moodle in order to reap the advantages offered by useful and usable LMS. The 18 features required to be enabled by Moodle, and the 17 detailed usability problems, together with the ten suggestions to improve the design of Moodle that were identified in this research, provide guidance regarding the features and usability issues which should be taken into consideration when designing and/or evaluating an LMS to achieve useful and usable system which satisfies users.

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Layla Hasan holds a BSc degree in computer science from the University of Jordan, Jordan in 1996; an MBA degree in business administration from the University of Jordan, Jordan in 2004; and a PhD degree in computer science from the Loughborough University, UK in 2009. Her research interests include web-based human computer interaction, website usability methods, web analytics, and website quality.

She is currently an associate professor in Software Engineering/Human Computer Interaction (HCI). She began teaching at Zarqa University in 2010 as an Assistant Professor in Software Engineering in accordance with a nine-year scholarship commitment. In the five years following her PhD and performing at an excellent standard, she was promoted to Associate Professor in Software Engineering/Human Computer Interaction. Besides her work as a teacher and a researcher, she worked as an editorial secretary for The International Arab Journal of Information Technology (IAJIT) for three years. She also worked as a director of the General Secretariat of the Colleges of the Computing and Information Society in the Association of Arab Universities for three years. She had more than 30 publications in international conferences and journals, and she is a reviewer for many international conferences and journals.