



PRIMARY RESEARCH

Efficiency and Interactivity Evaluation between Blackboard and Moodle

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Keywords

Evaluation
LMS
Usability
Efficiency
Interactivity
Hypothesis testing
Paired *t*-testing
Comparison
Navigation

Received: 11 February 2022**Accepted:** 04 April 2022**Published:** 11 June 2022

Abstract

The pandemic of COVID-19 resulted in the closure of universities and colleges worldwide, making the Learning Management System (LMS) an ideal approach for delivering education. Online LMS can provide a smooth communication channel between teachers and students. The LMS should be designed in such a way that it can address the challenges of distance learning while also assisting communities in learning during lockdowns. A LMS can be described as an online education hub that includes a comprehensive collection of educational activities such as classroom instruction and distance education. This paper will discuss the usability of LMS that focus on interactivity and efficiency among two LMS, blackboard and moodle. Primary data was collected from 87 learners, all of whom were university students at Bath Spa University RAK, through a questionnaire. The collected data was sorted and organized through SPSS. The paired *t*-testing was applied with a 95% interval level that compares the *p*-value with 0.05 to evaluate if the efficiency and interactivity of moodle and blackboard are the same. According to the result, it was concluded that they're not the same in terms of efficiency and interactivity. With the experiment results, we found that moodle is more efficient and interactive than blackboard for Bath Spa University academic center RAK students.

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I. INTRODUCTION

The needs of students in today's global world for education include rapid information exchange and increased usability to aid them in their learning, which is why many universities implement LMS to deliver their education. The LMS enables instructors to track students' progress and performance throughout the course. It has a function that keeps track of students' records, grades, submissions, and participation in the course. Similarly, it aggregates critical files and documents provided by the students on the site [1].

Both blackboard and moodle are LMS with many similarities in terms of providing services, but some key differences make each one special in its own way. The Blackboard Learning System enables teachers to publish course information, resources, readings, assignments, and basic discussion and collaborative features from a blackboard. Moodle is a free open-source Course Management System (CMS) that was created with strong pedagogical ideas in mind to

assist educators in creating effective online learning communities [2].

Much research has been conducted on both LMS regarding online learning effectiveness, development, perspective, and ideas based on nationality. In many of these research papers, both LMS had a fair share of benefits and drawbacks highlighted. However, usability testing for efficiency and interactivity conducted by researchers from different universities, such as Saudi Arabia, Protegees, and Agrarian University, includes different criteria, such as effectiveness, architecture, and language, focusing on one specific nationality. Research conducted by Zabolotniaia in the year 2020 explains the efficiency of moodle in terms of user interaction as friendly and easy to navigate [3]. At the same time, Li conducted research in 2021 praising the user design of Blackboard [4]. Mariano emphasizes on the structure of Blackboard as easy to understand [5], while Murillo indicates the simplicity of the moodle structure [6].

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Furthermore, since the researchers are targeting only undergraduate students, for this research, the collected data will include undergraduate and some post-graduate students from different nationalities such as Pakistani, Indians, Philippines, Bangladeshis, Sri Lankans, and Arabs, giving it a more enhanced and rich evaluation for both LMS. This will help us to evaluate which LMS would be preferred (for efficiency and interactivity).

The structure of the paper includes the abstract, an introduction that will also include the gap, followed by the literature review that includes the subheadings, which are usability criteria, efficiency, interactivity, research conducted previously on moodle and blackboard, research reviews for both LMS, a methodology that will explain the data-collection, questionnaire design, experiment results that will include the findings, discussion, a statement of limitations, and, in the end, references.

II. LITERATURE REVIEW

A. Usability Criteria

We need to understand that in any platform, including LMS, one of the important factors for defining quality for all software is usability, a crucial factor in developing successful interactive software applications. Usability is the most extensively used notion in the field of software engineering, as it specifies the demand for and use of a software system. Due to the extensive importance of this quality criterion, usability professionals and academics have offered a variety of usability evaluation methodologies [7].

Software engineering theorists, most notably Nielsen, established a usability design technique to systematically improve human-computer interactions in software programs, making them easier to use, more pleasant, and more effective for their users. Later on, a technique for assessing the quality and performance of systems was established to ensure their overall functionality by assessing users' experience and their level of comfort and satisfaction while working with the systems. Usability is essential from the user's perspective since it enables users to execute tasks accurately and operate the system in a pleasant mood rather than feeling frustrated. From the developer's perspective, usability is critical in determining a system's success [8].

B. Efficiency

One of the selected usability criteria for this research is efficiency. Efficiency can be explained by how easily a user can complete a task at a given time [9]. A study was conducted to examine the idea of system quality and the dimensions of usability, accessibility, reliability, and stability to deter-

mine the effect of these characteristics on the efficiency of an e-learning system. The findings indicate that usability is a critical dimension that influences system quality. That system quality is also the primary factor that determines whether an LMS is efficient or not [10].

C. Interactivity

Interactivity, one of the usability criteria, contributes to the user's satisfaction and the quality of any software. According to the research conducted by Croxton, the lack of interactivity in any online software can contribute to the user's frustration and lack of interest and can even be a reason for a student to drop out if they're perusing their studies completely online [11].

An interactive operating system allows direct interaction between the user and the operating system while one or more programs are executing. This will be accomplished through the use of a user interface. It could be a command line-based interface or a graphical user interface. It is a well-established principle that the user's role must be recognized while attempting to comprehend interaction as a social phenomenon [12].

D. Research Conducted on Moodle and Blackboard

When it comes to LMS, moodle and blackboard are frequently the front-runners for educational institutes and universities. Both are intended for distinct purposes.

Researchers such as Rice and William claim that moodle is an LMS that is not only free but provides its users with the ability to create engaging, powerful, and interactive online learning experiences [13]. The word moodle was originally an acronym for modular object-oriented dynamic learning environment, which is typically used by programmers and educational theorists [2], claims that moodle provides better control in terms of mastering the materials and qualitative control. It provides services that facilitate the delivery of materials in a foreign language [13].

On the other hand, Blackboard has considered one of the leading LMS products utilized more frequently by Europeans. It is mostly adopted by many US and UK institutions for being well known for providing a password-protected environment and well-organized admin tools that facilitate online teaching [13]. Unlike moodle, Blackboard is not a free platform. The costs are estimated according to the organization's demand and requirements. Because of its password-protected environment, blackboard is considered by many as expensive. According to [14], Blackboard provides comprehensive and flexible e-learning services to its users, such as students and faculty [15].

E. Reviews on both LMS

According to the research conducted by [16], both blackboard and moodle were stated to be easy to use, easy to navigate, well organized, and perceived as providing many tools. Still, Blackboard received more positive comments than moodle and fewer negative comments than in moodle. What separates blackboard from moodle in terms of aspects of satisfaction is its similarity to WebCT, which will facilitate the positive transfer of learning, a superior grade book, and a user-friendly interface. The research also stated that when two expert users of moodle learned how to use an LMS, they loved it very much, but overall, research participants tended to be more satisfied with Blackboard than with moodle. Another study was conducted for students in a Portuguese university to evaluate the extent and depth of use of the two LMS's. According to the result, more students (46.5%) indicated a preference for Blackboard over moodle, while 34.7% favored moodle, and nearly 20% had no preference [17]. According to Bremer and Bryant [18], students seem to prefer Blackboard on most counts. Interestingly, they liked the grading system of Blackboard as it offered a weighted grade. In contrast, moodle just displayed the raw score, so the students had to perform their weighting calculations. While [19] state that open-source systems are gaining popularity in higher education "because they have a much lower cost, can be more customized, make license management easier, and are community-driven and community serving" in contrast to the expense of commercial LMS. They argue that the speedy growth and community acceptance of open-source products can lead to the creation of effective and reliable systems that measure up favorably to commercial software. Moodle was selected for its performance with an explicit lead according to various performance criteria examined by evaluators, including the International Journal of Computing and ICT Research. Moodle has been built on the philosophy of maximum instructor control and minimal administrator control [17]. Various activities that are a fundamental part of the teaching-learning process, such as video lectures, assignments, forums, wikis, blogs, quizzes, tracking, etc., are provided and supported by moodle. Moodle can be used as a tool to build rich collaborative learning communities. Researchers [20] explained in their study that effectiveness and efficiency are the factors that directly affect students' attitudes toward using Moodle; furthermore, they also emphasized that the strongest and most significant determinant of students' attitudes toward using moodle is efficiency.

III. METHODOLOGY

Research Question: Which LMS is preferred by undergraduate and postgraduate students studying at Bath Spa University Academic Center, RAK?

For the methodology part, primary data was collected through an online questionnaire using Google forms for the Bath Spa RAK University students, who have been using both LMS for their studies for at least one year. Study Lab is named after moodle, while Blackboard as Minerva. Students from different nationalities and age groups will give this research more diverse findings and opinions. Permission was taken from the university administration head and program leader to conduct the questionnaire among the students. The participants for this research are controlled since only students studying at Bath Spa University RAK are allowed to participate. Any other users, such as teachers, admins, or managers, will not be included in collecting the data. Students were selected, having participants from both genders and age groups, from 17 to 25 and 26 to 40, as postgraduate students were also included.

Based on collected data, hypothesis-paired *t*-testing was applied to evaluate whether moodle and blackboard are the same in terms of efficiency and interactivity. Tools such as SPSS were used. The paired sample *t*-test, also known as the dependent sample *t*-test, is a statistical process for determining if the mean difference between two sets of observations is zero. This testing helps to evaluate the significant difference among the data, especially when there is a comparison [21].

A null hypothesis is a statement with no link between two variables. A null hypothesis depicts no observed effect, whereas an alternate hypothesis reflects some observable effect [22]. In the literature review, we can see that many researchers have provided positive feedback for both LMS. Therefore, it could be possible that both moodle and blackboard can be considered equal in terms of efficiency and interactivity. That is why, for this research, a neutral approach was taken so that the difference can be verified and further explained by the experiment results, which show which LMS is better than the other.

Null Hypothesis H0: The efficiency of moodle is the same as that of blackboard.

Null Hypothesis H00: The interactivity of moodle is the same as the interactivity of blackboard.

A. Survey Design

To design the questionnaire, the criteria of usability that are compared have been identified first. These are:

- User interactivity includes the availability of services

like communication tools and information for assistance and help.

- User efficiency, download and upload the files, including time and issues in uploading the file (can be related to the file size and types of files materials). Navigation or access to learning materials includes structure style of materials, ease of access to subheadings, and clarity arrangement of each course and the additional materials within them.

The questionnaire for the study comprises 3 sections. The first section describes the participants' basic information as students in the BSU and consists of 2 simple questions: age and the program they're studying under.

The second and third sections include specific questions about the usability criteria for the efficiency and interactivity of blackboard and moodle. There are a total of 19 questions; 13 are for efficiency, and 6 are for interactivity.

TABLE 1
CRITERIA FOR EFFICIENCY AND INTERACTIVITY

Criteria	Item
Efficiency	Which LMS requires fewer steps in registration?
	Which LMS has more issues with you uploading the files?
	Which LMS consumes a lot of time in loading?
	Which LMS is easier to navigate? (Finding the courses, materials, and additional resources)
	Which LMS is preferred in terms of efficiency?
Interactivity	Which LMS provides better access to communication tools?
	Which LMS provides better access to contact details in terms of assistance?
	Which LMS is preferred in terms of interactivity?

Table 1 is shown above. The questions were asked for LMS. The efficiency would be evaluated based on the collected data (responses from the questionnaire) on the following efficiency criteria for both LMS:

- Less registration steps
- Issue in uploading the files
- Easy navigation to the courses (modules students are enrolled in)
- Easy navigation to the materials (lectures, power-point, files)
- Easy navigation to additional resources (open-source library, exercises)
- LMS preference in terms of efficiency

Similarly, the interactivity would be evaluated on the following criteria:

- Easy accessibility to the communication tools (chat-bot, emails)
- Easy accessibility to the contact details in terms of assistance.
- LMS preference in terms of interactivity.

The questions were asked for LMS. After collecting the data, the data was first compiled, cleaned, and sorted out using the Microsoft Excel platform, applying the relevant functions such as count-ifs, and sums, and applying the descriptive statistics to see if there was an error (missing data). Once the data cleaning was sorted out, hypothesis testing

was applied using the SPSS tool.

B. Hypothesis Testing

The following hypothesis was tested:

Hypothesis 0: The efficiency of Moodle is the same as that of Blackboard. Efficiency criteria are issues in uploading the files, time loading, finding courses, lectures, and additional resources. We are comparing the p -value at the 95-confidence interval level with an evaluation of the p -value of the attempted tests with a 0.05 value. If the evaluation shows a 0.05 p -value, our Null Hypothesis H0 for the efficiency would be accepted. If it's not true, then our H0 Null Hypothesis for efficiency would be rejected. Below is Fig. 3 shows the paired t -testing statistics, and Fig. 4 shows the t -test result.

→ T-Test

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Moodle_file_upload_issu	1.9080	87	.29064	.03116
	Blackboard_file_upload_issu	1.7701	87	.42320	.04537
Pair 2	Moodle_time_load	2.4828	87	.62621	.06714
	Blackboard_time_load	2.3908	87	.70474	.07556
Pair 3	Moodle_easy_courses_n	1.0345	87	.18352	.01968
	Blackboard_easy_courses_n	1.3103	87	.46532	.04989
Pair 4	Moodle_easy_access_teach_materials	1.0805	87	.27358	.02933
	Blackboard_easy_access_teach_materials	1.4368	87	.49886	.05348
Pair 5	Moodle_easy_access_resources	1.1609	87	.36959	.03962
	Blackboard_easy_access_resources	1.2874	87	.45515	.04880

Fig. 1. Paired Sample Statistics

Fig. 1 shows the basic statistics of the paired data for efficiency.

		Paired Samples Test								
		Paired Differences				t	df	Sig. (2-tailed)		
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper				
Pair 1	Moodle_file_upload_issue - Blackboard_file_upload_issue	13793	34683	03718	06401	-21185	3.709	86	.000	
Pair 2	Moodle_time_load - Blackboard_time_load	09195	29064	03116	03001	15390	2.951	86	.004	
Pair 3	Moodle_easy_courses_navigation - Blackboard_easy_courses_navigate	-27586	44954	04820	-37167	-18005	-5.724	86	.000	
Pair 4	Moodle_easy_access_materials - Blackboard_easy_access_materials	-35632	48169	05164	-45898	-25366	-6.900	86	.000	
Pair 5	Moodle_easy_access_resources - Blackboard_easy_access_resources	-12644	33427	03584	-19768	-05519	-3.528	86	.001	

Fig. 2. Paired Sample Test

Fig. 2 shows the test result of the *t* and *p*-value for our paired data for the efficiency of blackboard and moodle. As we can see, the mean difference, which is for pair 1; Moodle file upload issue, which means subtracting the blackboard file upload issue, the average is 0.13793, which is not zero, therefore there is a difference that exists between the means. Similarly, for pair 2, it is 0.09195, which is also quite close, indicating there is a difference, but not that great. Pair 3 gives a mean difference of -0.27586, pair 4 is -0.35632, and pair 5 is -1.2644. All of this indicates a difference between moodle and blackboard means for efficiency.

Looking at the *t* value, which is 3.709 for pair 1, 2.951 for pair 2, -5.724 for pair 3, -6.900 for pair 4, and 3.528 for pair 5, some of the values are positive while some are negative. It does not impact our main result, depending on which pair value is put first. Furthermore, looking at the *p*-value, which is the last column (sig. (2-tailed)), we can see that all of them are less than 0.05 (95 confidence interval), proving that our null hypothesis H0 is rejected for efficiency.

To test the validity of our paired *t*-test result, the pairs were switched in the following way so that our hypothesis could confirm that the results would still be rejected.

Fig. 2 shows that the *t* value is not zero for all pair results. Furthermore, the *p*-value is not greater than 0.05, which means that the hypothesis is rejected even if we switched the pair values for blackboard and moodle efficiency.

The next hypothesis for interactivity was also tested using the same testing method:

H00: The interactivity of moodle is the same as that of blackboard.

The testing applied was again paired with *t*-testing sample tests. Interactivity criteria are easy accessibility of communication tools and easy accessibility of assistance in both LMS.

For this test as well, a 95-confidence interval level was taken that evaluates the *p*-value of 0.05 and see whether or not it's greater than 0.05 to accept or reject our H00 Null hypothesis.

Fig. 3 shows the descriptive statistics, and Fig. 4 shows the testing results:

		Paired Samples Statistics			
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Moodle_easy_access_communication_chat - Blackboard_easy_access_communication_chat	1.9540	87	.90101	.09660
Pair 2	Moodle_easy_access_contact_help - Blackboard_easy_access_contact_help	1.4368	87	.78801	.08448
	Moodle_easy_access_contact_help - Blackboard_easy_access_contact_help	1.9310	87	.94982	.10183

Fig. 3. Paired Sample Statistics

		Paired Samples Test								
		Paired Differences				t	df	Sig. (2-tailed)		
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper				
Pair 1	Moodle_easy_access_communication_chat - Blackboard_easy_access_communication_chat	-.34483	.47807	.05125	-.44672	-.24294	-6.728	86	.000	
Pair 2	Moodle_easy_access_contact_help - Blackboard_easy_access_contact_help	-.49425	.76956	.08154	-.65635	-.33216	-6.601	86	.000	

Fig. 4. Paired Sample Statistics

As we can see, the pair 1 mean difference, which is, moodle_easy access communication chat and Blackboard_easy access to communication chat, is -0.34483. Furthermore, pair 2 moodle_easy access to contact help and blackboard easy access to contact help also have a mean difference of -0.49425. The *t*-value, which is -6.728 for pair 1 and -6.601 for pair 2, means there is a difference between the moodle and blackboard interactivity criteria. Furthermore, looking at the *p*-value, which is the last column (Sig. (2-tailed)) for pair 1 is 0.000 and for pair 2 is also 0.000, which is less than 0.05 (95 confidence interval). Proving that our H00 Null Hypothesis is rejected for interactivity as well. The same validity testing would be applied to see if, when the LMS pairs are switched for the *t*-testing, the H00 hypothesis would still be rejected or not: Below, Fig. 5 shows the results.

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Blackboard_easy_access_communication_chat - Moodle_easy_access_communication_chat	.34483	.47807	.05125	.24294	.44672	6.728	86	.000
Pair 2	Blackboard_easy_access_contact_help - Moodle_easy_access_contact_help	.49425	.76056	.08154	.33216	.65635	6.061	86	.000

Fig. 5. Paired Sample Test

Fig. 5 shows the pair t -testing results when the LMS is switched. It can be seen in Fig. 6 that, again, the t -values are not zero and the p -values for both pairs are less than 0.05, proving that the H_0 Null Hypothesis is rejected in this case as well.

IV. RESULTS

Eighty-seven students filled out the survey, all BSU RAK students. Of the students studying under the programs for

Business and computing, 46.4% of students aged between 16 and 19, 20 and 25 were 47.6%, while those aged 25 and above were 6%.

Students with bachelor's (undergraduate) qualifications were 82.1%, while 17.9% were studying for a master's (post-graduate). This shows that undergraduate students answered the majority of the survey. A further illustration of the result is shown in Tables 1, 2, and 3.

TABLE 2
REGISTRATION STEPS AND USER- PREFERENCES FOR MOODLE AND BLACKBOARD

Criteria's	Moodle	Blackboard	Both	None	Result
Less steps for registration?	57.1%	10.7%	26.2%	6%	Moodle received 46.4% more responses in terms of having fewer registration steps
LMS preference in terms of efficiency	71.8%	28.2%	-	-	Moodle received 43.6% more responses when it comes to efficiency from the students
LMS preference in terms of interactivity	68.2%	31.8%	-	-	Moodle received 36.4% more responses when it comes to interactivity by the students

TABLE 3
REGISTRATION STEPS AND USER- PREFERENCES FOR MOODLE AND BLACKBOARD

Criteria for Efficiency	Yes	No	Some- times/ Maybe/ Don't know	Result	Comparison
Issues in uploading the files in Moodle	9.5%	90.5%	-	The majority of the students do not have any issues uploading the files	In Moodle, 90.5 % of the students do not have any issues uploading the file, while for Blackboard, 77.4% of responses say they do not have issues in file uploading, which is 13.1% less as compared to Moodle.
Issues in uploading the files in Blackboard	22.6%	77.4%	-	The majority of the students do not have any issues uploading the files	For 57.1% of the students, Moodle sometimes takes a while to load. That is 3.5% more than the Blackboard.
Time for loading the Moodle LMS	7.1%	35.7%	57.1%	For the majority of the students, the Moodle LMS sometimes takes a while to load	However, 11.9% responded that Blackboard takes time to load, which is 4.8% more than Moodle.
Time for loading the Blackboard LMS	11.9%	34.5%	53.6%	For the majority of the students, the Blackboard LMS sometimes takes a while to load	Moodle received 96.4% of responses regarding easily finding the courses, which is 27.4% more than Blackboard.
Easy navigation to access the courses in Moodle	96.4%	3.6%	-	Most students find it easy to locate their courses in Moodle.	Moodle received 92.9% of responses when it came to easily find the teaching materials, which is 36.4% more than Blackboard.
Easy navigation to access the courses on Blackboard	69%	31%	-	Most students find it easy to locate their courses on Blackboard.	
Easy to find materials in Moodle (lectures, videos, etc.)	92.9%	7.1%	-	The majority of the students find it easy to locate their teaching materials in Moodle	
Easy to find materials in Blackboard (lectures, videos, etc.)	56.5%	43.5%	-	Most students find it easy to locate their teaching materials on Blackboard.	
Easy to find additional resources (open library, online courses) in Moodle	83.5%	16.5%	-	The majority of the students agree that additional materials are in Moodle.	Moodle received 83.5% of responses regarding the availability of additional resources, which is 12.9% more than Blackboard.
Easy to find additional resources (open library, online courses) on Blackboard	70.6%	29.4%	-	The majority of the students agree that additional materials are on the Blackboard.	

Table 3 shows the interactivity criteria for moodle and blackboard

V. FINDINGS

A. Data Visualization for Moodle and Blackboard's Efficiency

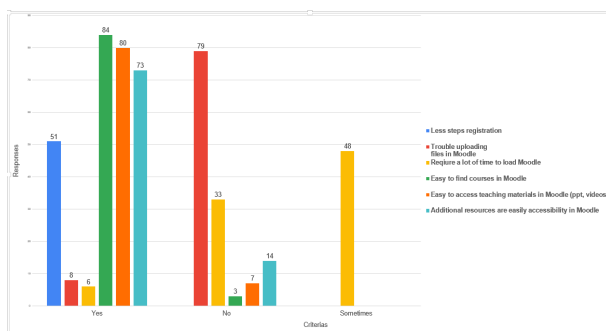


Fig. 6. Responses for Moodle for the efficiency criteria

As shown in Fig. 7 above, moodle received 51 responses for fewer registration Steps, meaning 51 out of 87 students who answered the questionnaire agreed that moodle has fewer registration steps. For the trouble uploading the files in moodle, 8 out of 87 students agreed, while 79 out of 87 disagreed, showing us that most students do not have any trouble uploading the files in moodle. For the next part, which is require a lot of time to load, 6 out of 87 agreed, 33 out of 87 disagreed, while 48 out of 87 said that sometimes moodle does take time to load. For the easy to find the courses in moodle, 84 out of 87 agreed, while 3 out of 87 disagreed, showing us that almost all students find it easy to locate their courses in moodle. For the easy access to teaching materials in moodle, like Powerpoint lectures, 80 out of 87 agree. At the same time, 7 out of 87 disagree, showing

us that almost all the students find it easy to locate their lectures in moodle. For the additional resources easy accessibility in moodle, 73 out of 87 agree. At the same time, 14 out of 87 disagree, showing us that most of the students have easy accessibility to the additional resources in moodle LMS.

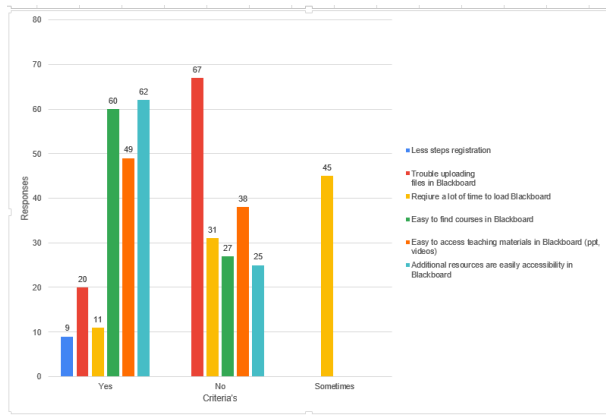


Fig. 7. Responses for Blackboard for efficiency criteria

As shown in Fig. 7 above, blackboard received 9 responses for fewer registration steps, meaning 9 out of 87 students who answered The questionnaire agreed that Blackboard has fewer registration steps. For trouble uploading the files in Blackboard, 20 out of 87 students agreed while 67 out of 87 disagreed, showing us that majority of the students do not have any trouble in uploading the files in Blackboard. For the next part, which is require aot of time to load, 11 out of 87 agreed, 31 out of 87 disagreed, while 45 out of 87 said that sometimes Blackboard does take time to load. For the easy to find the courses in blackboard, 60 out of 87 agreed, while 27 out of 87 disagreed, showing us that most students find it easy to locate their courses in Blackboard. For the easy access to teaching like materials Powerpoint lectures In blackboard, 49 out of 87 agree. At the same time, 38 out of 87 disagree, showing us that most students find it easy to locate their lectures on Blackboard. For the additional resources easy accessibility in blackboard, 62 out of 87 agree. At the same time, 25 out of 87 disagree, showing us that most students have easy accessibility to the additional resources in blackboard LMS. Fig. 8 illustrates the comparison of both moodle and blackboard LMS for the efficiency criteria.

As shown in Fig. 8, fewer registration step for moodle is 51 and for blackboard is 9, showing us that moodle requires fewer registration steps than blackboard. Trouble uploading the files for moodle in terms of answering yes is only 8, while for blackboard it is 20, showing that fewer students faced issues in uploading files in moodle as compared to Blackboard.

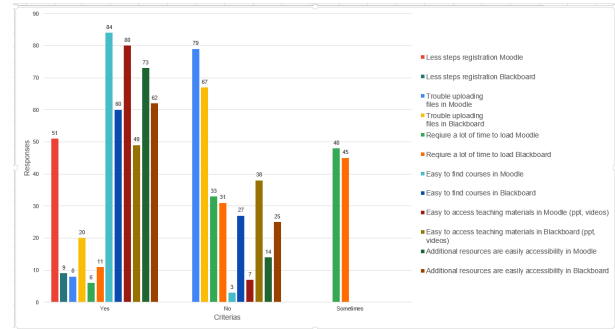


Fig. 8. Responses for Moodle and Blackboard for the efficiency criteria

The next part, which is required alot of time to load, in terms of answering yes, for moodle is only 6, while for Blackboard, it is 11, proving that fewer students agree that moodle takes time to load as compared to Blackboard. easy to find courses in terms of answering yes. For moodle, it is 84, and for Blackboard, it is 60, showing that students find it easier to find their courses in moodle LMS than on blackboard. easy to access teaching material (PPT, VIDEOS) in terms of answering yes, for moodle is 80 and for blackboard is 49, again proving that students find it easier to locate their teaching materials such as lectures and videos in moodle as compared to blackboard. Additional resources are easily accessible in answering yes, for moodle is 73 and for blackboard is 62, again proving that students find it easier to locate additional resources such as open-source libraries, videos, etc., for moodle as compared to Blackboard. Moodle Interactivity: Fig. 8 illustrates the responses for moodle in terms of interactivity criteria.

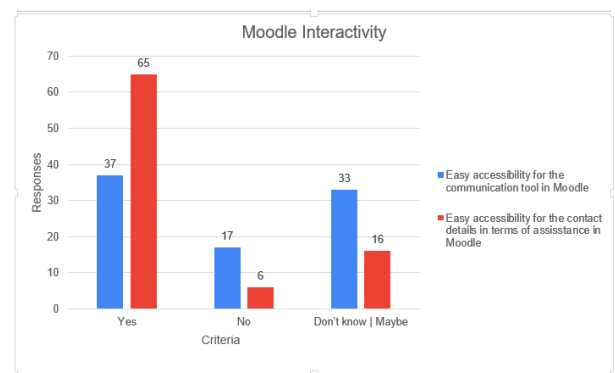


Fig. 9. Moodle responses for interactivity criteria

As shown in Fig. 9 above, for easy accessibility for communication tool in moodle, 37 out of 87 agreed, and 17 out of 87 disagreed. At the same time, 33 out of 87 chose the maybe option, showing us that the majority of the students found it easy to access the communication tool in moodle. For the next part, which is easy accessibility for the details in terms of assistance in moodle, 65 out of 87 agreed, 6 disagreed, and 16 out of 87 chose the maybe option, showing us that

the majority of the students find it easy to access the contact details when they need any assistance.

Blackboard interactivity: Fig. 10 illustrates the responses for blackboard in terms of interactivity criteria.

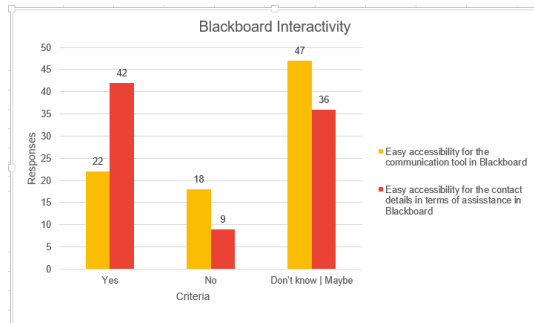


Fig. 10. Blackboard Interactivity

As shown in Fig. 10 above, for easy accessibility for the communication tool in blackboard 22 out of 87 agreed, and 18 out of 87 students disagreed. At the same time, 47 out of 87 chose the maybe option, showing us that most students had a vague idea about Blackboard accessibility. For the next part, easy accessibility for the contact details in terms of assistance in blackboard, 42 out of 87 agreed, 9 disagreed, and 36 out of 87 chose the maybe. This option shows us that the majority of the students find it easy to access the contact details when they need any assistance in Blackboard.

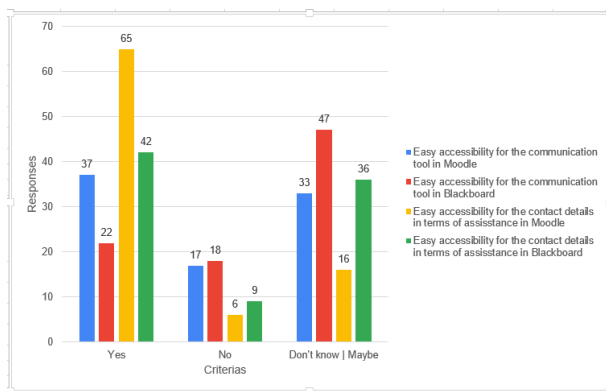


Fig. 11. Moodle and blackboard interactivity responses

In both figures, we can see that easy accessibility for the communication tool, in terms of yes, is 37 and Blackboard is 22, showing that students find it easier to access the tools for communication in moodle as compared to Blackboard. Easy accessibility for the contact details in terms of assistance for yes, moodle got 65, and Blackboard is 42, showing us that the students find it easier to access the contact details for assistance in moodle as compared to Blackboard. According to the research and findings, it's clear that moodle and blackboard are not equal in terms of efficiency and interactivity, as proved by the results of paired *t*-testing in

SPSS, which for all ranges between -6.5 till + 6.5, which was further verified when the LMS data was switched for the *t*-testing as shown in Tables 2 and 3.

The collected data from the students show a strong preference for moodle LMS as compared to Blackboard, as shown in Fig. 8 and 11.

This answers our research question that was: Which LMS is preferred by undergraduate and postgraduate students studying at the Bath Spa university academic center, RAK? The answer is moodle. BSU RAK students prefer moodle LMS, proving that it is more efficient and interactive.

VI. DISCUSSION

The Null Hypothesis was used for this research paper because there were almost equal numbers of drawbacks and benefits concluded by other researchers, so it was confusing to pick one LMS over the other. The Null Hypothesis approach was taken to find the difference and which is preferred by the students.

To collect the data for this research, permission was requested from the program leader and administration head to allow the online questionnaire to be distributed among the students at the university. The data collection process was initiated before the winter break. During that time, many students were busy with their semester one assessments. Therefore, when they were asked to fill out the questionnaire, they were not giving it any priority. In order to gain more responses, the students were asked to fill out the form continuously during classes and in group chats for three days.

VII. IMPLICATIONS

Throughout this research, it was concluded that moodle is more efficient than Blackboard. However, certain factors the students highlighted can be considered to improve the overall functionality and usability. For example, it was highlighted by the students that it does take some time for moodle to load, whereas, for Blackboard, students have some difficulty accessing their courses and other materials like communication tools, etc. These factors can be improved. Furthermore, moodle can also include a weighted grading system, as highlighted in the literature review, in their new and upcoming versions to improve their services.

VIII. STATEMENT OF LIMITATION

The collected data is based on the student's preferences, not on the technical aspect of the LMS. It does not technically test the back-end working, nor does it evaluate other factors that contribute to the usability, such as theme, color, speed, plugins, and other administrative parts, mostly because it's

usability-based research. However, it would be better to include such factors. There is no expert testing for both of these LMS. The research focuses on usability for the students only; it does not include other users, such as admins, teachers, and managers. The reason for including only students was that the majority of the users were students who had the least amount of control. Adding more users with different control levels could have enhanced this research's findings. The collected data had 87 students with the criteria; only those with experience using both LMS for at least one year would be included. This could also mean that there might be students who have used one LMS for more than 2 years. This is considered a drawback because it's possible that someone who has 2 years of experience on one LMS as compared to the other would also fill out the questionnaire. Naturally, if any user has had a grip on one piece of software for 2 years, they would prefer it over the one they might have used for only a year.

IX. CONCLUSION

This study aimed to examine the usability of moodle and Blackboard, two rival learning management systems at Bath Spa University, Rak. Two usability indicators were utilized: user efficiency; downloading and uploading services; material organization and user interactivity, access to the communication tools, and contact details for assistance. eighty-

seven Bath Spa University students were used as samples. The findings indicated that students favored the usability of the moodle learning management system above that of blackboard. The research result was concluded according to our hypothesis testing for both efficiency and blackboard, both of which were rejected, proving that moodle and Blackboard are not the same in terms of efficiency and interactivity for Bath Spa University students. The experiment results proved that moodle is more efficient and interactive than blackboard for the Bath Spa University RAK students, as the majority preferred moodle over blackboard, as shown in Fig. 8 and 11, and Table 1, which provides a detailed comparison of both LMS.

X. FUTURE WORK

This study can be replicated in the future with a bigger sample of students from other universities. This research can be enhanced by including more usability criteria for evaluation. Furthermore, more users would be included in the testing, as only students were targeted for this research. Other users such as teachers, managers, course creators, and admins will be included so that more users' Perceptions and understanding are also included. Usability experts can also be included to verify both LMS testing and other users' experiences.

REFERENCES

- [1] A. Al-Ajlan and H. Zedan, "Why moodle?" in *12th IEEE International Workshop on Future Trends of Distributed Computing Systems*, Kunming, China, 2008.
- [2] F. Martin, "Blackboard as the learning management system of a computer literacy course," *Journal of Online Learning and Teaching*, vol. 4, no. 2, pp. 138-145, 2008.
- [3] M. Zabolotniaia, Z. Cheng, E. Dorozhkin, and A. Lyzhin, "Use of the LMS moodle for an effective implementation of an innovative policy in higher educational institutions," *International Journal of Emerging Technologies in Learning*, vol. 15, no. 13, pp. 172-189, 2020. doi: <https://doi.org/10.3991/ijet.v15i13.14945>
- [4] N. Li, X. Xu, R. Wang, and X. Liu, "Design and implementation of a high-precision campus intelligent blackboard inspection system based on AI," in *IOP Conference Series: Earth and Environmental Science*, Xi'an, Shaanxi, China, 2020.
- [5] O. Matarirano, N. Jere, H. Sibanda, and M. Panicker, "Antecedents of blackboard adoption by lecturers at a South African higher education institution-extending GETAMEL," *International Journal of Emerging Technologies in Learning*, vol. 16, no. 1, pp. 60-79, 2021. doi: <https://doi.org/10.3991/ijet.v16i01.16821>
- [6] G. G. Murillo, P. Novoa-Hernández, and R. S. Rodriguez, "Technology acceptance model and moodle: A systematic mapping study," *Information Development*, vol. 37, no. 4, pp. 617-632, 2021. doi: <https://doi.org/10.1177/0266666920959>
- [7] N. Bevana, J. Kirakowskib, and J. Maissela, "What is usability?" in *Proceedings of the 4th International Conference on HCI*, Stuttgart, Germany, 1991, p. 24.
- [8] J. Nielsen, "Usability inspection methods," in *Conference Companion on Human Factors in Computing Systems*, Boston, MA, 1994.
- [9] S. Palmer and D. Holt, "Staff and student perceptions of an online learning environment: Difference and development," *Australasian Journal of Educational Technology*, vol. 25, no. 3, pp. 366-381, 2009. doi: <https://doi.org/10.14742/ajet>

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- [10] K. Hornbæk, "Current practice in measuring usability: Challenges to usability studies and research," *International journal of human-computer studies*, vol. 64, no. 2, pp. 79-102, 2006. doi: <https://doi.org/10.1016/j.ijhcs.2005.06.002>
- [11] N. M. Radwan, M. B. Senousy, and M. Alaa El Din, "Current trends and challenges of developing and evaluating learning management systems," *International Journal of e-Education, e-Business, e-Management and e-Learning*, vol. 4, no. 5, pp. 361-375, 2014. doi: <https://doi.org/10.7763/ijeeee.2014.v4.351>
- [12] P. B. Lowry, N. C. Romano, J. L. Jenkins, and R. W. Guthrie, "The CMC interactivity model: How interactivity enhances communication quality and process satisfaction in lean-media groups," *Journal of Management Information Systems*, vol. 26, no. 1, pp. 155-196, 2009. doi: <https://doi.org/10.2753/MIS0742-1222260107>
- [13] S. Kapsargina and J. Olentsova, "Experience of using LMS MOODLE in the organization of independent work of bachelors in teaching a foreign language," in *International Scientific Conference "Far East Con"(ISCFEC 2020)*, Vladivostok, Russia. Atlantis Press, 2020.
- [14] V. Nkonki and S. Ntlabathi, "Teaching and learning innovations on blackboard: What form and function?" in *International Conference on e-Learning Kuala Lumpur*, Malaysia, 2016.
- [15] A. Alghafis, A. Alrasheed, and A. Abdulghany, "A study on the usability of moodle and blackboard Saudi students perspectives," *International Journal of Interactive Mobile Technologies*, vol. 14, no. 10, pp. 159-165, 2020. doi: <https://doi.org/10.3991/ijim.v14i10.14381>
- [16] N. Marksburry, Q. Zhang, and C. Post. (2015) A pilot study of CMS usability testing: Blackboard and moodle. [Online]. Available: <https://bit.ly/3yVtITt>
- [17] S. Palmer and D. J. Torgerson, "Definitions of efficiency," *The BMJ*, vol. 318, no. 7191, pp. 1136-1137, 1999. doi: <https://doi.org/10.1136/bmj.318.7191.1136>
- [18] D. Bremer and R. Bryant, "A comparison of two learning management systems: Moodle vs blackboard," in *Proceedings of the 18th Annual Conference of the National Advisory Committee on Computing Qualifications* Tauranga, New Zealand, 2005.
- [19] M. Gozdiskowski and W.-F. Chen, "Open source software in virtual university development: An overview," in *Association for the Advancement of Computing in Education (AACE)*, Waynesville, NC, 2007.
- [20] B. Šumak, M. Heričko, M. Pušnik, and G. Polančič, "Factors affecting acceptance and use of moodle: An empirical study based on TAM," *Informatica*, vol. 35, no. 1, pp. 91-100, 2011.
- [21] M. Xu, D. Fralick, J. Z. Zheng, B. Wang, F. Changyong *et al.*, "The differences and similarities between two-sample t-test and paired t-test," *Shanghai Archives of Psychiatry*, vol. 29, no. 3, pp. 184-188, 2017. doi: <https://doi.org/10.11919/j.issn.1002-0829.217070>
- [22] R. W. Frick, "The appropriate use of null hypothesis testing," *Psychological Methods*, vol. 1, no. 4, pp. 379-390, 1996. doi: <https://doi.org/10.1037/1082-989X.1.4.379>