The Adoption and Use of Moodle in Online Learning: A Systematic Review

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Abstract: The rapid evolution of ICT has enabled several institutions to adopt Moodle as their preferred e-learning platform. Moodle is increasingly being used for interactive, personalised, and collaborative learning and improving online assessments. Despite Moodle's increasing popularity, there are limited reviews on the empirical evidence of its efficacy among students. The study aimed to provide an overview of the scientific literature on the studies that investigated the behavioural intention and actual usage of Moodle. This review shows that Moodle is mainly used in universities and effectively improves student performance, attitude, and satisfaction. Most studies that applied a theoretical ground applied the Technology Acceptance Model (TAM). Meanwhile, performance expectancy, effort expectancy, facilitating condition, perceived usefulness of professors, perceived ease of use, and subjective norms are essential drivers for online learning systems' acceptance or actual usage. These findings serve as evidence and reference for educational institutions in developing online learning policies and strategies. Further studies need to incorporate behavioural and motivational theories when designing Moodle courses.

1 Introduction

Technological advancement has recently transformed higher education and enhanced administration and teaching. Student learning has been vigorously promoted and supported by the introduction of ICT and online services [1]. E-learning networks are increasingly becoming a critical part of the dynamic e-learning approach across multiple platforms. Some commonly adopted e-learning systems include the Learning Content Management System (LMS), the Learning Content Management System (LCMS), the Learning Design System (LDS), and the Learning Support System (LSS) [2].

Essentially, LMS refers to a range of programs or systems that offer online educational services to educators, learners, and administrators [3]. The platform administers online learning resources on a wide range of instructional subjects. Moreover, many institutions commonly use LMS to facilitate online learning [3]. Among these, the Modular Object-Oriented Dynamic Learning Environment (Moodle), with over 250 million registered users as of 2020, is one of the most prominent open-source LMS platforms worldwide [4]. The platform generates and offers interactive and dynamic online courses without geographical limitations. Several researchers identify Moodle as a convenient and efficient LMS that provides a robust collection of learning-centric resources that facilitates teaching and learning [5]–[6].

During the COVID-19 pandemic, over one billion students in 129 countries worldwide were affected [7]. In response to the COVID-19 outbreak, many universities worldwide switched to Emergency Remote Teaching (ERT) via online platforms [8]. There was a shift from the conventional approach to online and blended learning approaches [9]. Consequently, this led to the rise in the adoption of Moodle across several learning institutions worldwide.

As a result, the effectiveness of Moodle and students' learning outcomes and engagement have become a matter of concern for universities in particular and society in general. Despite the growing popularity of Moodle, there are limited reviews in this context. These studies mainly focus on Moodle's challenges [10], limited to a single country [11], and the application of a single theory [12]. Although several scholars have conducted studies, this topic is still under-explored. This systematic review aims to evaluate the effectiveness of Moodle in universities, the most common

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predictors of its adoption, and the theories researchers applied. The objective is to identify significant practical implications for Moodle's usefulness and understand how to enhance the platform's success.

2 Methodology

2.1 Search Strategy

This study followed the guidelines suggested by the referred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist [13], combined with an author-concept approach to categorize the literature according to its relevance to the topics of the study. The process was carried out in five phases: 1) searching the literature in two databases (Google Scholar, IEEE Xplore, SCOPUS, and Web of Science) according to relevant keywords; 2) screening the selected literature; 3) applying the inclusion/exclusion criteria; 4) categorizing and analyzing the literature; and, 5) communicating the findings. The four databases were reviewed in November 2021 and updated in January 2022. The main keywords were the prefixes TITLE-ABS-KEY Moodle*, Online Learning*, e-learning*, and Students* that find any records that include Moodle in any form across title, abstract, or keywords.

The initial database searches identified 1240 Moodle-related articles. Other sources yielded a total of seventeen additional items. The literature was reviewed from 2015 to 2021, including journal articles, conference proceedings, book chapters, and papers published in English. This screening reduced the number of articles found to 634. The pre-screened papers were retrieved from the relevant databases and checked for duplication. After removing duplicates, the abstracts from the remaining 634 papers were examined, and we excluded 547 papers. We read the full text of the remaining 69 papers and eliminated 37 publications not directly linked to this study. Some studies were ruled out because they were prospective studies with no empirical evidence, and the methodology was not well defined, or pilot studies. As a result, 32 journal papers were selected for this systematic review. "Fig 1" illustrates the research identification procedure.
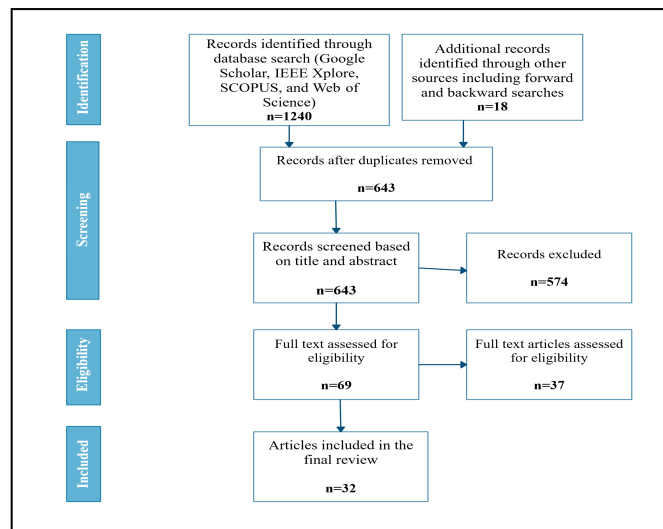

Fig. 1. PRISMA flow chat

2.2 Research Questions

We established the study's research questions based on the significant purpose of this systematic literature review. Given this, we aim to gain insight into the research area and categories and the acceptable outcomes presented in the studies. Moreover, the study emphasizes existing evidence, gaps, and the field's future direction. The study questions are formulated as in Table 1.

Table 1 Research Question

| ID	Research Question	Motivation
RQ1	Which theories were implemented in the studies?	To identify the theories used in the studies.
RQ2	What variables had the most impact?	To identify the most significant variables in the studies.
RQ3	What was the outcome of the studies?	To identify the outcomes of the studies.
RQ4	What were the limitations of the studies?	To identify the limitations of each study.

2.3 Inclusion and Exclusion

The study applied several inclusion and exclusion criteria to filter the article for further exploration. Table 2 shows the criteria.

Table 2 Inclusion and exclusion criteria

Criteria		
Inclusion	I1	The study must have investigated the use of Moodle.
	I2	Peer-reviewed Full papers (including peer-reviewed conference papers)
	I3	Full papers (including full conference papers)
	I4	Empirical research (qualitative and quantitative)
	I5	Explained research methods
Exclusion	E1	Studies that did not target use of Moodle.
	E2	Extended abstracts or 'work-in-progress' papers
	E3	Not empirical research
	E4	Research methods not adequately explained

3 Results and Discussion

A summary of the main characteristics of the included studies is presented in this section. The publication dates spanned from 2010 to 2022. During this period, most studies were published in journals (n=29, 91%), with two in conference proceedings (6%). One study was published in a book chapter (3%). The findings are illustrated in "Fig 2."
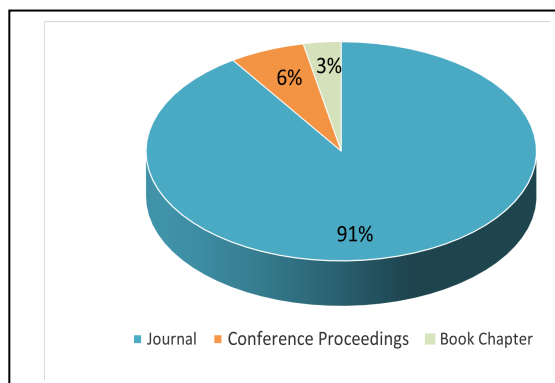

Fig. 2. Publication venue of papers

We analysed the research techniques and approaches adopted in the studies. This process led to the discovery that twenty-two (22) papers used the quantitative approach, accounting for more than half of the total. Two studies were based on a qualitative design. Furthermore, the combination of the two main methodologies was found in six (6) studies, while experimental and Artificial Neural Network (ANN) was applied in other studies. Moreover, most studies had a satisfactory Cronbach's alpha reliability coefficient (>0.7), demonstrating the internal consistency of the measuring scales applied in the studies.

Table 3 Classification of studies by methodology

Main Methodology	*Frequency*
Quantitative	22
Mixed Methods	6
Qualitative	2
Experimental	1
Artificial Neural Network (ANN)	1
Total	*19*

Most studies included only university students (n=27, 84%), while the two studies (6.25%) included only secondary school students. The remaining studies included instructors/teachers (n=1, 3%). Moreover, fourteen studies were performed in Asia, 12 in Europe, six in the Middle East, and six in Africa. One study was conducted by authors based in New Zealand, but it was unclear where the study itself was carried out. "Fig 3" illustrates the geographical location of

the studies. Samples were composed of individuals aged between 16 and 60 years. The sample size ranged from 32 [14] to 2000 [15] participants.
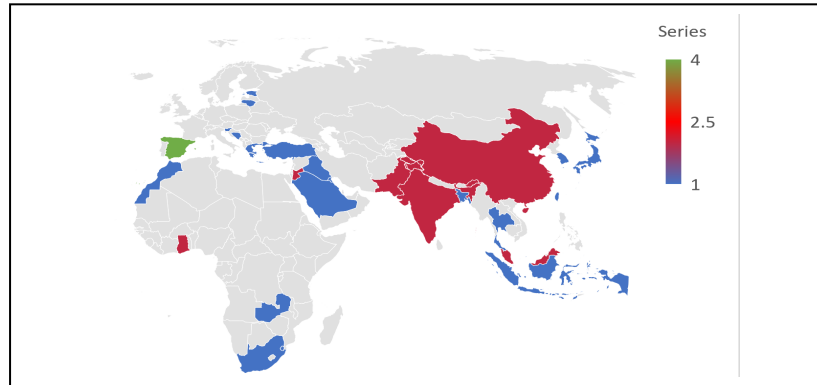

Fig. 3. Number of studies per country

Seventeen studies evaluated behavioral intention (BI) to use Moodle, five examined Actual Usage (AU), and three focused on Satisfaction. Eight of the included studies investigated users' attitudes. The remainder (n=1) attempted to predict the Continued Usage of Moodle (Hsu & Chang, 2013). The variables were measured using self-reported instruments based on 7-point (n=6, 18.8%), 5-point (n=15, 46.9%) or 4-point (n=1, 3.1%) Likert scales. The measurement scale employed in three studies was not reported [16]–[18].

In 2022, three papers were published, five in 2021, four in 2020, and six in 2019. Also, four papers were published in 2014, three in 2016, and two in 2013. In addition, one article was published in each of the years 2018, 2017, 2015, 2013, 2011, 2012, and 2010. As reflected in "Fig 4," our findings suggest a significant increase in Moodle research trends from 2019 to 2022.
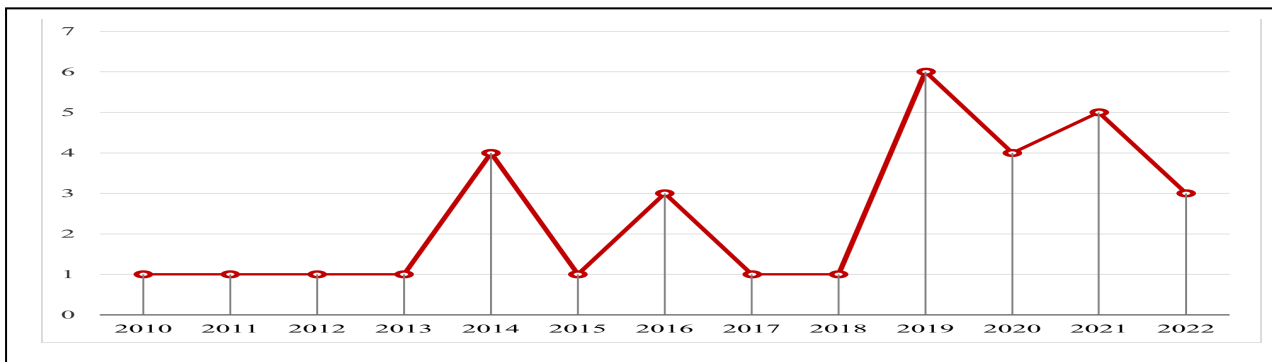
Fig. 4. Number of studies published per year

The selected articles have 2753 citations, with an average of 86. In detail, [19] has the most citations with 649, [20] has 633, and [1] with 321. Also, [21] has 204 citations and [22] has 137, as highlighted in "Fig 5."
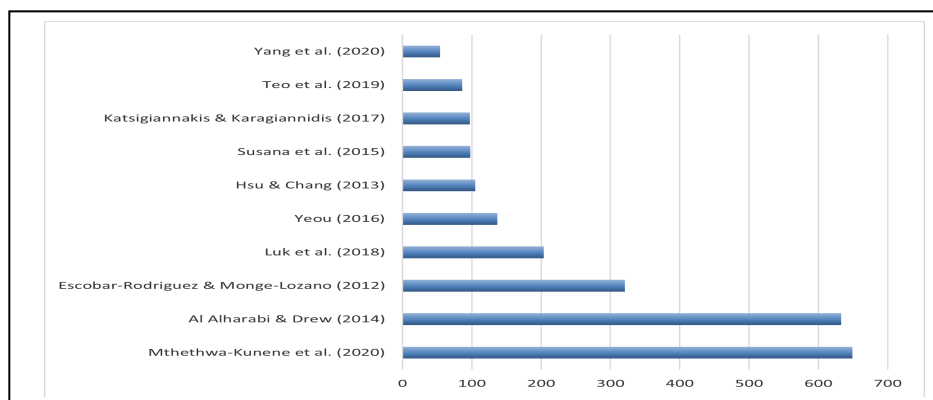
Fig. 5. Top 10 cited studies

3.1 Which theories were combined with TAM?

The selected studies reported six different theories applied to investigate the adoption and post-adoption of Moodle. The identified theories include the Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), UTAUT2, Information System Success Model (ISSM), Cognitive Evaluation Theory (CET), Diffusion of Innovation Theory, and Self-determination Theory (SDT). The findings can be seen in Table 4. Significantly, TAM (n=16) was the most commonly used theory across all studies. This result is consistent with previous studies [10], [23], [24], which established TAM as one of the most mentioned theories analysed in technology adoption. Studies argue that TAM efficiently explains users' behaviour towards technology [25]. It further demonstrates the suitability of TAM for investigating the behavioural intention and actual usage of Moodle and other e-learning systems. Notably, the studies that employed TAM extended it (xTAM) with external variables. One rationale for extended TAM could be that the model is insufficient to explain users' adoption and use of new technology [26] because the model does not consider other factors that could influence acceptance and willingness to use technology.

TAM was mainly applied to determine Behavioural Intention and Actual Usage. Likewise, UTAUT (n=4) was used to predict Behavioural Intention. Sixteen studies found TAM beneficial; however, one study found it ineffective. Surprisingly, PU had a weak influence on system use in one study [27], similar to [28]. The findings contradict previous research that PU significantly affects the system use [29]. Interestingly, two studies integrated two models [18], [30]. Applying integrated theories for behaviour change is an emerging area to consider in future studies in line with [31].

Table 4 Integrated theories identified

Theories	*Frequency*	*Study*
TAM	15	[1], [19], [20], [22], [27], [30], [32]–[41]
UTAUT	4	[42], [45], [44], [45]
UTAUT2	2	[16], [46]
SDT	1	[18]
CET	1	[18]
ISS Model	1	[6]
DIT	1	[30]

3.2 What variables had the most effect?

In the selected studies, we observed the effect of exogenous on the endogenous variables and extracted variables with the most significance. Twenty-four studies applied variables with an average of seven. Study variables ranged from eleven [39] to five [19], [37]. Our study findings suggest that PE, EE, FC, PU, PUP, PEOU, SN, Satisfaction, and Attitude predict online learning intention and actual usage. The comparison is presented in Table 5.

Literature [23], [45], [47], [48] shows the importance and effect of TAM variables (PU and PEOU) on BI or CU. Similarly, our findings align with previous studies that identified FC, EE, Attitude, and Satisfaction as significant. Of note, most studies reported EE, System Quality, and Information Quality to have a negligible impact on behavioral intention to use Moodle. Notably, some studies identified barriers to the effective use of Moodle, including unstable electricity, price, poor network connectivity, and lack of technical support.

Table 5 Table type styles

Exogenous	*Endogenous*	*No of Studies*
Attitude	BI, AU	6
Performance Expectancy	BI	4
Perceived Ease of Use	AU	4
Facilitating Conditions	BI	3
Satisfaction	BI, AU	2
Effort Expectancy	BI	2
Subjective Norms	BI	2
Social Influence	BI	2
Perceived Usefulness for Professor	BI	2

3.3 What were the study outcomes?

The empirical studies were examined to identify the behavioral outcome featured in the papers (reported in Table 5). The psychological outcomes were studied quantitatively in 22 of the 32 empirical studies. The analysis of psychological outcomes indicates that the empirical research on Moodle is primarily interested in how the technology is perceived and

experienced by users. It identifies if the system is enjoyable or helpful and inspires people to adopt and use it. Most commonly, the empirical research papers examined perceptions towards adopting and using Moodle. Several studies used a theory to understand the predictors of Behavioural Intention (BI) and Actual Usage (AU). To a lesser extent, other studies applied qualitative and mixed methods to investigate the perceived barriers to Moodle adoption and use.

Other frequently studied psychological outcomes reflect the most common reasons for implementing Moodle. It is because online-learning aims to increase students' motivation to learn. In addition, Attitude, Student Engagement, and Student Performance outcomes are also included in the studies. Similarly, in the context of student engagement, two studies applied a gamification strategy to enhance motivation toward various activities and specific tasks in Moodle. Generally, many empirical studies examine motivation as a psychological outcome.

Further aspects such as the perceptions of usefulness, effectiveness, and ease of use or effort required to use a system were frequently examined as psychological outcomes. According to technology acceptance and adoption theories, these aspects are critical determinants for the continued use of various systems [49].

3.4 What were the limitations of the integrated theories?

We extracted limitations observed in the selected studies. Table 6 provides an overview of nine limitations identified in the analysis. According to the study findings, we identified the issue of external validity as most studies (94%) were conducted in a single locality. Also, studies were restricted to a specific group, hence the need for a cross-cultural perspective in future studies [50]. Prior studies show that culture and local attitudes toward technology use can differ across regions, influencing study outcomes [51], [52]. Some studies were not theory-driven. Applying a theoretical framework helps justify the study's importance and significance [53]. Further, a model or motivational theory provides more precise and consistent predictions.

Notably, most studies were cross-sectional for a short period. Given this, user behavior is dynamic, and longitudinal research may provide more insight into the development of user behavior. Furthermore, these variables should focus on designing an online learning system. New constructs should ideally solidify and support prediction. Hence, future research should examine the impact of constructs in other theories that have not been applied not identified in this review.

Also, most of the retained studies were quantitative with different sampling approaches. The self-reported responses may affect the study outcome, making it difficult to make conclusions. Hence the need to apply a qualitative or mixed-method approach to validating the findings and better understanding. Another factor not considered in the selected studies is the impact of user experience and years of experience. Most current literature contends that user experience (UX) is critical to user adoption [47], [54]. It follows that a positive or negative user experience with an online learning system can promote or discourage behavioral intention or continuous usage [23]. Prior computer experience significantly impacts their PEOU and attitude towards online learning technologies [55], [56].

Other limitations of the evidence base include the lack of studies assessing prior computer experience and other motivational factors that may influence intention to use technology. For example, further models like Task Technology Fit (TTF) examine technology's fit to users' tasks/requirements [57]. The theory explores the post-adoption aspect of technology utilization. However, there is a need to include new variables to address the effects of course material, course quality, instructor material, and students' perspectives.

Table 6 Limitations in the studies

Description of Limitations	*Recommendation*
Some studies did not apply a grounded theory or Model.	Model or motivational theory provides an easier, clearer, and more consistent predictions.
All studies were performed over a short period, with the majority being cross-sectional.	Longitudinal Studies will give a better account of the actual usage behaviour over a longer period. Also, the experimental design provides more specific conclusions.
Not Generalisable – most studies were limited to only one country (external validity).	Studies carried out in multiple universities using diverse study populations will improve the generalizability of the results. Moreover, the moderating effect of culture should be considered.
Did not consider the moderating effect of gender and age differences.	The inclusion of moderators can give a better outcome.
Some studies did not measure the Actual Use Behaviour of Moodle users – the focus was mainly on behavioural intention.	Investigate factors related to the actual usage of online learning post-adoption stage.

Description of Limitations	Recommendation
Different sampling approaches used in the studies.	Specific sampling approaches to determine its appropriateness.
Did not consider computer skills and years and users' years of experience.	Students' computer level and years of user experience can significantly affect user engagement and performance.
Consider other variables related to the instructors and learners or quality of instruction and system/service quality.	Instructors and students related variables to better understand the determinants of student's adoption and use of Moodle.
Students' motivational factors were not considered.	Motivational factors offer better insights into how students are motivated and encouraged to continue to engage with Moodle post-adoption stage.

4 Conclusion

This study examined the literature on Moodle acceptance and continuance intention of university students. In addition, the significant variables predicting user acceptance and continued usage of Moodle were assessed. In this context, our research demonstrates the relevance and usefulness of various models for investigating Model continuance intention. It can be seen that Performance Expectancy, Effort Expectancy, Facilitating Condition, Perceived Usefulness, Perceived Ease of Use, Social Norms, Satisfaction, and Attitude are essential drivers for behavioural intention and use of Moodle.

Consequently, online learning technologies like Moodle should be designed according to users' acceptance of technology and intention to continue using it. Similarly, the findings underscore the need for developers to establish a solid understanding of the factors predicting user acceptance of Moodle. Because of this insight, they can develop online learning systems that align with the stakeholders' needs. Future research is needed to substantiate our findings and make them more relevant to validate the models identified in this analysis.

There are some limitations of this study to highlight here. One limitation is that reporting bias is possible as the search was limited to English and peer-reviewed studies only: it is likely that these limits reduced the number of studies that could have been identified and potentially included in the review. As with any review, there is a possibility that studies that report unfavorable results are underreported (not published), leading to more favourable interpretations of the evidence base. Another limitation is that meta-analysis was not possible due to the large degree of heterogeneity between studies in terms of the target population and outcomes measured. Furthermore, it is crucial to recognise the possibility of reporting and publication biases.

Given the previous, the findings are an essential contribution to current models for technology acceptance and use process utilized in online learning literature. Most studies were conducted using only one model, primarily TAM. The studies extended the models with external variables. However, some external variables were drawn from the literature without proper justification. Theoretically, our study suggests that TAM with various dimensions was very useful in enhancing the model's explanatory power. All things considered, the study findings add to the current literature in multiple ways but also assist scholars and practitioners in gaining a better knowledge of user behaviors in the online learning context, specifically Moodle.

Acknowledgment

Conflict of interest

The authors declare that there is no conflict regarding the publication of this paper.

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