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Students' Perspectives on the Real Use of Interaction in E-Learning Using Moodle at Algerian University

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Abstract: Despite the widespread adoption of Learning Management Systems (LMS) in higher education, empirical evidence on how students actually interact within these platforms remains limited, particularly in North African contexts. This study explores the real use of interaction in e-learning environments at two Algerian universities, drawing on Moore's (1989) interaction framework to examine three dimensions: learner–content interaction (lesson access), learner–learner interaction (peer engagement), and learner–instructor interaction (teacher communication). A cross-sectional survey was administered to 616 randomly selected students from the faculties of education at Algiers 2 and Setif 2 universities. Data were collected using a structured questionnaire validated through expert review, with acceptable internal consistency (Cronbach's α = .77). Descriptive analysis revealed a pronounced preference for informal digital channels over the institutional Moodle platform across all three interaction dimensions. For lesson access, 74% of students relied on social media groups compared to only 13% who used Moodle. Peer interaction occurred predominantly through social media (63%) and private messaging (18%), with no students reporting peer engagement via Moodle. Teacher–student interaction showed a critical gap: 48% of students reported no interaction with their instructors, 42% engaged via video conferencing, 7% via private messages, and, again, no students interacted with teachers via Moodle. These findings reveal a systematic disconnect between institutional platform availability and actual student use, suggesting that Moodle functions primarily as a static content repository rather than an interactive learning environment. The study recommends redesigning Moodle courses with interactive features, strengthening teachers' digital presence, and integrating formal and informal platforms to create more balanced and effective e-learning ecosystems.

Keywords: E-Learning, Learning Management Systems, Moodle, Higher Education, Moore's Interaction Framework, Social Media, Algeria.

Introduction

A major aspect of the COVID-19 pandemic was the shift from traditional to digital technologies (Prokopenko, 2023), prompting universities and educational institutions worldwide to adopt digital learning platforms rapidly. During the pandemic, online learning platforms have become an innovative approach to learning, using digital technologies to create accessible online tools (Prokopenko, 2023). Globally, leading universities focus most of their efforts on online learning, in particular through innovative learning platforms such as Moodle (Modular Object-Oriented Dynamic Learning Environment) (Sibgatullina et al., 2022). It is one of the most widely used Learning Management Systems (LMS) for delivering e-learning. Since the pandemic, Moodle has been a cornerstone of online education because of its open-source nature, flexibility, and robust features. According to Elbourhamy (2023), Moodle was chosen during the COVID-19 pandemic for its distinctive features that facilitate interaction between students and teachers. E-learning is not just a temporary response to the crisis, but has also paved the way for a long-term transformation in higher

education. University campuses were forced to close due to the pandemic, disrupting traditional face-to-face teaching. Most higher education institutions have adopted the new learning system to minimise disruptions to teaching and learning (Chin et al., 2020). During the pandemic, many universities, including Algerian universities, delivered their lessons via Moodle (Maulana & Lintangsari, 2021). To ensure continuity in education, Algerian universities quickly embraced online learning, and Moodle became a crucial tool. This platform supports synchronous and asynchronous learning, facilitates communication, and provides a centralised course management system, making it a great choice for remote classrooms.

After COVID-19, Moodle continued to play an important role in Algerian higher education as the university embraced hybrid and blended learning. As a result of the platform's ability to support flipped classrooms and self-paced learning, it is a valuable tool for teachers. Furthermore, Moodle's analytics tools enable teachers to track student progress and engagement, thereby enhancing teaching strategies and improving learning outcomes (Suad et al., 2023). Al-Ajlan and Zedan (2008) indicate that Moodle's analytics capabilities proved particularly beneficial during the pandemic for identifying at-risk students and providing timely intervention. Universities could also integrate tools for video conferencing, quizzes, assignments, and collaborative activities into the platform to meet their specific needs. The platforms not only provided interactive access to knowledge but also enabled real-time interaction between students and teachers, allowing for flexible learning environments across all time zones (Prokopenko, 2023). Effective e-learning requires meaningful interaction, because any form of learning, especially e-learning, depends heavily on student interaction. Moore (1989) argues that successful online learning depends on three basic types of interaction: interaction between the learner and the content, between the learner and the teacher, and among learners. In addition to being distinct, these three modes are interconnected and work together to create an engaging learning environment. Learning experience satisfaction is an important indicator of e-learning quality, as reflected in learners' perceptions of their learning experience (Alqurashi, 2019). Moore's (1989) framework remains a fundamental concept for comprehending interpersonal interactions in distance education, despite its demonstrated strengths and weaknesses across various educational contexts. For example, Weidlich and Bastiaens (2018) showed that more interaction does not always mean less transactional distance, especially in LMS-based settings where interaction is more about following rules than teaching. In addition, Bower (2017) argued that digital platforms can create "illusory interactions," challenging Moore's assumption that interaction quality improves learning.

Additionally, cultural and pedagogical traditions play an important role in mediating interaction patterns-an aspect often overlooked by Moore. This framework offers a robust conceptual lens, but contextual, cultural, and technological factors limit its explanatory powers. To explore the real use of these three types of interaction in Algerian university e-learning, this study examines students' attitudes towards them.

Research Focus

It has become increasingly necessary to analyse e-learning interactions in the Algerian context, given the rapid expansion of blended and online learning in higher education, often implemented without systematic evaluation of student-teacher interactions. This study provides empirical evidence to improve teaching quality, support teacher training, inform digital education policies, and increase student participation in Algerian higher education. Internationally, the research contributes to e-learning scholarship in developing countries by offering context-sensitive data from a non-Western setting, thereby enabling meaningful comparative studies and helping to balance the dominance of North American perspectives. In North African higher education, empirical research on interaction is scarce, and the dynamics of interaction in blended learning environments are poorly understood. This study addresses these critical gaps in the literature. Using real interaction patterns and relating them to learning outcomes, it offers a theoretically and practically grounded description of how interaction shapes e-learning effectiveness in Algeria.

Research Aim and Research Questions

The study aims to explore how students engage with course content in e-learning environments, focusing on the Moodle platform and the tools they use to engage with it.

RQ1: How do students access their lessons in E-Learning?

RQ2: How do students interact with their peers in E-learning, and through which channels?

RQ3: How do students interact with their teachers in E-learning, and through which channels?

Interactions in E-Learning

Learner-Content Interaction

According to Moore (1989), learner-content interaction is the process by which students engage with learning materials, resources, and content in an online course to gain a deeper understanding of the materials, resources, and content offered. As a consequence of this interaction, the learner will be required to read, watch videos, complete assignments, and interact with multimedia elements. To achieve learning outcomes, it is important that learners can process, understand, and internalise the content, which is the primary goal of the process. There is a great deal of focus on how students interact with text, multimedia, simulations, videos, interactive exercises, and other resources that are designed to convey information and facilitate understanding in the classroom. Mayer (2014) states that student-content interaction fosters a sense of ownership over the learning process when students are involved. With this method, students can become self-regulatory learners and take responsibility for their learning, allowing them to control their pacing, revisit challenging concepts, and explore areas of particular interest. Additionally, it provides students with a way to customise their learning experience by focusing on the areas they need more

support in and exploring the content at a pace that suits their individual needs, thereby enabling personalised learning.

Learner-Learner Interaction

To create dynamic online learning environments, teachers can leverage appropriate tools, strategies, and pedagogical approaches so that students can interact with and learn from one another, ultimately leading to more successful and fulfilling learning outcomes. As defined by Hrastinski (2009), learner-learner interaction is the communication and collaboration among students in an online teaching and learning environment. It is a crucial aspect of e-learning that significantly enhances the educational experience by promoting collaboration, engagement, and a deeper understanding of course material. As well as being a crucial component of effective e-learning environments, it facilitates communication, collaboration, and the exchange of ideas among students in online environments. (Hrastinski, 2009). This type of interaction not only fosters a sense of community but also enhances learning outcomes by strengthening critical thinking, problem-solving skills, and understanding of the learning process (Sapriati et al., 2024). According to Moore (1989) and Swan (2001), meaningful learner-learner interactions lead to higher levels of engagement, satisfaction, and academic success in online courses when learners interact with their classmates. This kind of interaction is facilitated in e-learning through activities such as discussion forums, group projects, peer reviews, and collaboration tools, including online collaboration platforms and video conferencing rooms. With these platforms, students are encouraged to actively participate in the learning process, share diverse perspectives, and organise their knowledge, which is critical to creating a dynamic and inclusive learning environment (Bendridi, 2021; Peramunugamage et al., 2024). Garrison et al. (1999) argue that these interactions are integral to the "community of inquiry" framework, a model in which social and cognitive presences intersect to support deep and meaningful learning among students.

Learner-Teacher Interaction

To create an engaging online learning environment, there needs to be a balance between instructors and students, as this can facilitate educational transactions that enhance learning outcomes (Iberahim & Sulaiman, 2023). The findings of Agbong and Agbong-Coates (2024) indicate that instructors who effectively communicate with students can significantly enhance students' participation, satisfaction, and retention when they use clear, supportive communication techniques. Moreover, instructors need to be well-prepared, as students respond positively to instructors who can effectively convey the course content (Iberahim & Sulaiman, 2023). Higher levels of student engagement have been associated with a strong instructor presence, characterised by accessibility and involvement (Agbong & Agbong-Coates, 2024). In online education, the quality of the teacher's presence significantly impacts learners' engagement and satisfaction, underscoring the importance of clear communication and active participation on the teacher's part. According to Simpson (2013), student-instructor interactions encompass a range of communication and feedback, including

individual feedback, discussion facilitation, and instructor guidance. There are various ways in which student-instructor interactions occur in online classrooms, including video, discussion forums, and real-time chats, allowing students and instructors to communicate in ways that suit their learning preferences and improve the quality of their interactions (Sapriati et al., 2024). Thus, to facilitate effective interactions between students and instructors, timely, constructive, and personalised feedback must be provided in a supportive learning environment to address students' individual needs and motivate them to achieve.

Materials and Methods

Data collection and sample

Due to the purpose of the study, which was to conduct an exploratory survey of the attitudes of students towards the real use of interaction in e-learning settings using Moodle in Algerian university settings. High school students from Setif-2 University in the east and Algiers-2 University in the Centre of Algeria participated in this study. A total of 616 students were randomly selected. In total, 700 copies of the questionnaire were distributed; 84 were incomplete or missing. All students (80.8% of them females) and 118 (19.2% of them males) are in the second and third years of the department of psychology and education.

Instruments and Procedures

The authors developed a questionnaire to collect information for this study. Checklists and dichotomous items were included in the questionnaire. Students were asked four questions, such as "how do you access your lessons in E-Learning" or "do you interact with your peers in E-Learning". The questionnaire was randomly distributed and was collected individually at the University of Setif 2 and Algier 2. The responses were collected by using the Statistical Package for the Social Sciences (SPSS 24). To establish the questionnaire's reliability, 30 students participated in a pilot study. (SPSS.V 24) was used to determine Cronbach's alpha. The results are in Table 1.

Table 1

Reliability of the Questionnaire.

Variable	Item	Alpha Cro
Interaction in E-Learning	4	0.766

Based on Cronbach's alpha value of 0.766, the questionnaire has acceptable internal consistency. According to this value, these items demonstrate satisfactory reliability and are suitable for use in an exploratory study.

Data Analysis

To analyse the responses, descriptive statistics were used, including percentages and means. Percentages helped in understanding the distribution and proportion of responses, while means provided an average measure of responses. This approach enabled a clear and systematic presentation of participants' responses, facilitating an objective interpretation of the findings.

Results

First: How do Students access their lessons In E-Learning

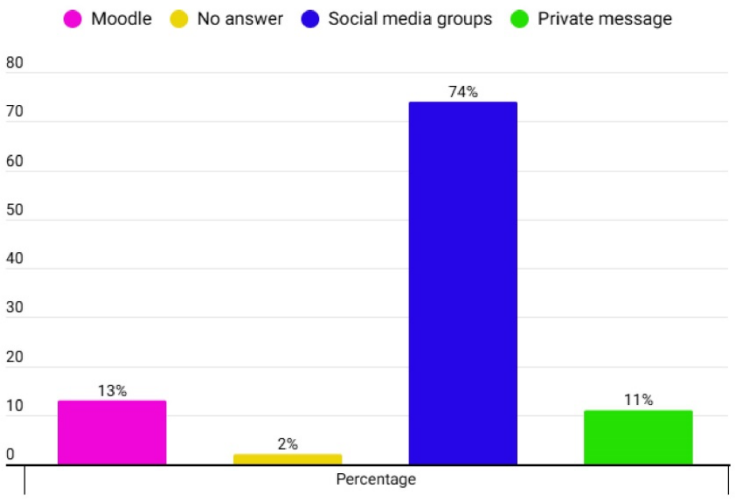
Table 2

Statistics

Way	Frequency	Percentage
Moodle	80	13%
No answer	12	2%
SM Groups	456	74%
Private Mess	68	11%

Figure 1

Way Students Access Their Lessons



Source: author's development

According to the graph, most students (74%) prefer to access their lessons through social media groups. In comparison, fewer rely on Moodle (13%), and only a small proportion use private messages (11%) or did not respond (2%).

Second: Did Students interact with their peers and how?

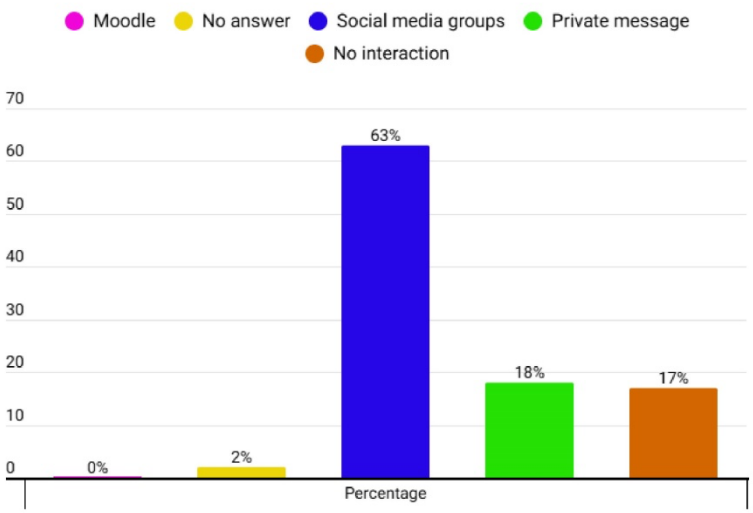
Table 3

Statistics

Stu-Stu Interaction	Frequency	Percentage
Moodle	00	00%
No answer	12	2%
SM Groups	388	63%
Private Mess	111	18%
No interaction	105	17%

Figure 2

Students-students Interaction



Source: author's development

According to the graph, most students (81%) interact with their peers using social media groups or texting them in private messages, whereas (17%) did not interact with their peers, and 2% did not respond.

Third: did students interact with their teachers and how?

Table 4

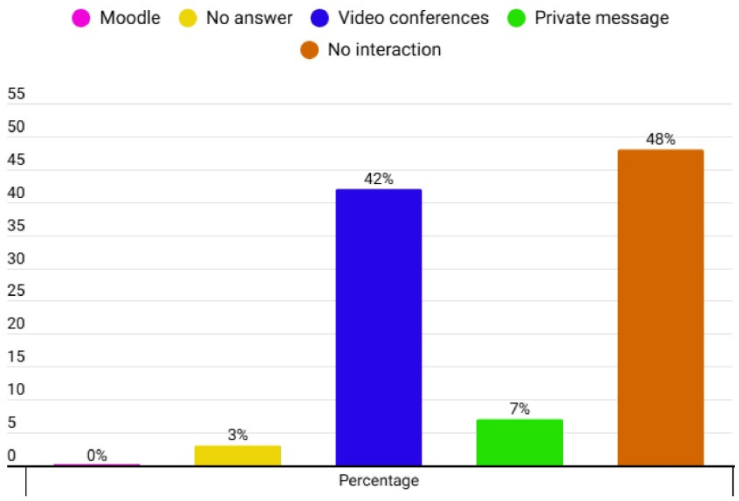
Statistics

Stu-Teac Interaction	Frequency	Percentage
Moodle	00	00%
No answer	18	3%

Video conferences	259	42%
Private Mess	43	7%
No interaction	296	48%

Figure 3

Student-Teacher Interaction



Source: author's development

Based on the graph, 48% of students did not interact with their teachers, 42% interacted through Video conference, 7% used private messages, no one used Moodle, and another 3% did not respond.

Discussion

Firstly, much research has documented social media's growing dominance as a tool for educational access (Al-Bahrani, Patel, & Sheridan, 2015; Manca & Ranieri, 2016 a). In part, these platforms are used to facilitate information sharing, peer collaboration, and lesson dissemination because they are easy to access and immediate. It may also be because they access it through their smartphones, which they have used since they were in primary school (Meziane Cherif, 2025b) and secondary school (Meziane Cherif, 2025a). The present findings align with Hamid et al. (2015), who argue that students often prefer social media over Learning Management Systems (LMS) because of their immediacy, interactivity, and convenience. However, the relatively low Moodle use observed in this study (13%) reflects a recurring challenge noted in other contexts. Despite being designed to support structured learning, LMS platforms are often perceived as less engaging or more difficult to navigate (Dahlstrom, Brooks, & Bichsel, 2014).

In contrast, Adeyeye et al. (2022), Gamage (2022), and Suad (2023) suggest that Moodle and similar LMS platforms enhance academic performance by providing structured access to resources, assessment tools, and feedback. The contrast illustrates a key tension in digital education: students

prefer informal platforms, while formal systems often guarantee quality and accountability. Further, the very small proportion of students who failed to respond (2%) and the marginal use of private messages (11%) suggest that individual, non-collaborative methods of online learning are marginal in the digital learning ecosystem. Despite this, Junco (2012) cautions that the widespread use of social media groups for academic purposes is not without risks. Despite their popularity, these platforms can lead to distraction, information overload, and the dissemination of inaccurate content. Alternatively, Moodle, a structured LMS, provides a pedagogically guided, more secure learning environment (Kumar & Sharma, 2016). All of these findings illustrate a broader global tension in digital education. While students overwhelmingly prefer social media platforms for their flexibility and familiarity, research consistently demonstrates that formal learning management systems offer unique pedagogical value in achieving high-quality educational outcomes. The future of higher education should not focus on replacing one system with another, but rather on integrating the strengths of both informal and formal platforms to balance accessibility and pedagogy.

Secondly, it is consistent with previous studies that identify peer interaction as a crucial component of online learning. It enhances social presence, facilitates knowledge sharing, and promotes collaborative problem-solving (Garrison, Anderson, & Archer, 2010; Hrastinski, 2009). Similarly, Tibingana-Ahimbisibwe et al. (2022) found that students who actively engage with peers in virtual environments build stronger learning communities and demonstrate higher levels of participation and persistence. Furthermore, (17%) reported that they did not interact with their peers, highlighting another challenge of e-learning. Kebritchi, Lipschuetz, and Santiague (2017) show that some students feel isolated, lack motivation, or have difficulty participating in online discussions. In online courses, Song et al. (2004) also observed that limited peer interaction is a major barrier to student satisfaction and learning effectiveness. Despite the benefits of interaction for most students, a significant minority still faces difficulties connecting.

Furthermore, not all learners view peer collaboration positively. According to Cho and Tobias (2016), some students prefer independent, self-paced learning and find peer interaction unnecessary or distracting. Consequently, peer interaction may not be equally beneficial for all students. In general, students' engagement in e-Learning is positively influenced by peer interaction. Nevertheless, a substantial proportion remains disengaged, indicating a need to balance collaborative learning with individual study habits.

Thirdly, there is a significant gap in student-teacher interaction, with half of the students avoiding direct interaction. According to Martin, Wang and Sadaf (2018), in online learning, teacher presence and accessibility are crucial for sustaining motivation and academic achievement. Additionally, Garrison, Anderson, and Archer (2010) note that teacher-student interaction significantly affects student engagement and satisfaction. The relatively high use of video conferencing (42%) is consistent with research showing that synchronous video conferencing enhances feedback, real-time interaction, and classroom-like dynamics (Rapanta et al., 2020). In contrast, Grey and DiLoreto's (2016) findings that individual teacher feedback fosters belonging and

improves learning outcomes are at odds with the limited use of private messages (7%) in this study. Cho and Tobias (2016) argue, however, that frequent interaction is not always necessary for all students, since independent learners tend to prefer limited teacher involvement. Overall, the results illustrate the broader challenge of balancing structured guidance and learner independence in online education. The 48% who did not ask questions and interact may reflect a preference for autonomy or a lack of confidence. The low student use of Moodle (0%) to interact with their teachers may be largely due to the predominance of PDF files shared by teachers. When course content is reduced to downloadable documents, the platform is perceived primarily as a repository rather than an interactive learning environment, which diminishes students' motivation to engage with its communicative and collaborative features. This result contrasts with (Fadieieva & Semerikov, 2024; Semerikov et al., 2025a; Semerikov et al., 2025b), which indicates that learner interaction in Moodle is strongly influenced by the nature of instructional content, with interactive, multimedia, and activity-based resources fostering higher levels of participation and engagement. The discrepancy can therefore be explained not by the inadequacy of the platform itself, but by pedagogical practices that underutilise Moodle's interactive affordances, such as forums, quizzes, feedback tools, and collaborative activities. Consequently, content design emerges as a decisive factor mediating the relationship between learning management systems and student interaction.

In general, the results indicate that students tend to prefer social media platforms over institutional Learning Management Systems (LMS) such as Moodle. The convenience, constant accessibility, faster communication, and mobile compatibility of social media may be contributing to this preference (Al-Samarraie & Saeed, 2018; Manca & Ranieri, 2016). Using Moodle primarily as a static content repository, without interactive features, leads students to shift their discussions to social media, where interactions seem less constrained (Al-Rahmi et al., 2022). In addition, cluttered layouts and excessive navigation steps within Moodle further discourage student engagement (Kakasevski et al., 2008). A social media tool, on the other hand, is lightweight, intuitive, and better suited to mobile use, especially in regions with limited digital infrastructure. However, Moodle can be an effective learning environment when it is carefully structured and includes an interactive component (Mohd Nasir et al., 2021). In addition to interacting with peers, students also find social media useful for communicating with their teachers. Al-Rahmi et al. (2022) and Mohd Nasir et al. (2021) report limited interactions with teachers via LMS platforms, describing them as rigid, slow, and unresponsive. Instructors frequently use Moodle to distribute static documents, including PDFs and Word documents, rather than to facilitate meaningful conversations. So we have to know that E-learning is not just uploading PDF files.

On the other hand, social media allows students to exchange information quickly and informally and to feel more connected with their instructors (Manca & Ranieri, 2016; Yusuf et al., 2016). Due to their immediate accessibility, these platforms are better suited for maintaining ongoing communication and providing timely feedback. It is also possible to interact with peers informally and dynamically through social media. As opposed to Moodle's structured forums, which

are often perceived as formal and task-driven, social media fosters spontaneous collaboration and community building (Kakasevski et al., 2008; Manca & Ranieri, 2016a). The integration of these platforms into students' daily routines makes them a natural space for both academic and social exchange (Al-Rahmi et al., 2022; Al-Samarraie & Saeed, 2018). However, Moodle's effectiveness is not solely dependent on its design; it also relies heavily on how it is used. In the absence of appropriate training, many teachers rely solely on Moodle for file sharing (Mohd Nasir et al., 2021; Lavidas et al, 2023). The use of course design tools, interactive pedagogy, and digital pedagogy in professional development programs has been shown to enhance teachers' confidence and creativity (Al-Fraihat, Joy, & Sinclair, 2020; Korsah, 2024).

In the same way, students need support in order to use Moodle effectively. Despite their familiarity with social media, many students struggle with Moodle's structured features, such as forums, quizzes, and submission systems (Mohd Nasir et al., 2021). A lack of training often restricts students from downloading materials from Moodle, preventing them from collaborating or learning more deeply. Students' confidence and satisfaction with the platform can be significantly improved by training workshops and ongoing technical support (Al-Fraihat, Joy, & Sinclair, 2020). It is important that instructors and students actively engage in the design and implementation of Moodle for it to be effective in supporting meaningful learning. In the absence of these conditions, social media will continue to fill the gaps left by traditional learning management systems.

Conclusions and Implications

The study highlights important theoretical and pedagogical implications regarding student interaction in digital learning environments. Their technical capabilities are not solely determinants of Learning Management Systems' effectiveness, but also of how they are pedagogically implemented and socially integrated. In terms of theory, the results support interaction-based learning theories that emphasise active engagement, communication, and social presence over passive access to content. LMS platforms are underutilised when used primarily as repositories for instructional materials. Furthermore, the study shows that students prefer an environment that provides immediate access, informal communication, and immediacy to understanding digital learning behaviour. It reflects the shift toward learner-centred digital ecosystems, where autonomy, perceived usefulness, and ease of interaction are key drivers of engagement. According to these findings, improving the effectiveness of digital learning requires a combination of technological infrastructure and pedagogical transformation, including the creation of interactive instructional designs and the enhancement of teachers' digital pedagogical skills. Moreover, the results emphasise the importance of institutional support for effective use of the LMS. A structured teacher training program and student orientation can enhance digital literacy, build student confidence, and foster more meaningful academic interaction. In addition, the results emphasise the importance of institutional support for effective use of the LMS. A structured teacher training program and student orientation can enhance digital literacy, build student confidence, and foster more meaningful academic interaction. It is also possible to create more balanced and inclusive learning environments

by integrating formal learning management systems with complementary digital communication tools.

Limitations

Firstly, the sample consisted of only 616 students from two Algerian universities (Algiers 2 and Setif 2), limiting the generalizability of the results to other institutions, academic disciplines, or regional contexts. While the sample size enabled descriptive statistical analysis, it did not represent the diversity of higher education institutions nationwide. The sample exhibited a notable gender imbalance, with 80.8% females and 19.2% males. This disproportion may have affected interaction patterns and limited our ability to study e-learning engagement by gender. Third, a brief four-question questionnaire was used to collect data. However, its limited scope may not fully reflect the complexity of student experiences in e-learning environments. Lastly, self-reported data may introduce response bias. In future research, larger, more balanced, and multi-institutional samples should be included.

Suggestions for Future Research

Results suggest targeted institutional and pedagogical interventions are needed to improve interaction within Moodle. First, professional development should focus on interactive instructional design, enabling teachers to use Moodle beyond content delivery and promote active learning through discussion forums, formative assessments, and feedback. Also, teachers' digital pedagogical competence is essential for fully exploiting the interactive potential of LMS platforms. Integrating Moodle with complementary communication tools, such as social media, may enhance academic structure and accessibility. Second, students' digital practices can be integrated into learning environments that are more responsive and inclusive. As well, students should receive structured orientation and technical support to enhance their digital literacy, as it is difficult for them to use LMS platforms effectively without guidance. By supporting teachers and students, institutions can improve participation and effectiveness in digital learning environments. Future research should explore hybrid digital learning models that blend formal and informal learning environments but maintain pedagogical coherence. It is also possible to explore the roles of teachers' digital competence, instructional design strategies, and students' motivational factors in shaping interactions within learning management systems. Further, longitudinal and experimental research designs would aid in understanding how digital interaction evolves and how specific pedagogical interventions can improve engagement and learning outcomes.

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None.

Conflict of Interest

The authors declare that they have no competing interests.

Ethical Considerations

The study followed ethical standards for research that involves human participants. During data collection, all students provided informed consent. The study was anonymous and confidential, and no personally identifiable information was collected. Data were used exclusively for academic research.

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References

Adeyeye, B., Ojih, S. E., Bello, D., Adesina, E., Yartey, D., Ben-Enukora, C., & Adeyeye, Q. (2022). Online learning platforms and Covenant University students' academic performance in practical-related courses during COVID-19 pandemic. *Sustainability*, *14*(2), 878. https://doi.org/10.3390/su14020878

Agbong, J. B., & Agbong-Coates, I. J. (2024). Instructors' presence and communication strategies on student engagement in asynchronous online classes. *International Journal of Educational Management and Development Studies, 5*(2), 206–232. https://doi.org/10.53378/353071

Al-Ajlan, A., & Zedan, H. (2008). The extension of web services architecture to meet the technical requirements of virtual learning environments (Moodle). *2008 International Conference on Computer Engineering & Systems*, 27–32. https://doi.org/10.1109/ICCES.2008.4772960

Al-Bahrani, A., Patel, D., & Sheridan, B. (2015). Engaging students using social media: The students' perspective. *International Review of Economics Education*, *19*, 36–50. https://doi.org/10.1016/j.iree.2015.06.001

Al-Fraihat, D., Joy, M., Masa'deh, R., & Sinclair, J. (2020). Evaluating E-learning systems' success: An empirical study. *Computers in Human Behavior*, *102*, 67–86. https://doi.org/10.1016/j.chb.2019.08.004

Al-Rahmi, W. M., Yahaya, N., Alturki, U., Alrobai, A., Aldraiweesh, A. A., Omar Alsayed, A., & Kamin, Y. B. (2022). Social media – based collaborative learning: The effect on learning success with the moderating role of cyberstalking and cyberbullying. *Interactive Learning Environments*, *30*(8), 1434–1447. https://doi.org/10.1080/10494820.2020.1728342

Al-Samarraie, H., & Saeed, N. (2018). A systematic review of cloud computing tools for collaborative learning: Opportunities and challenges to the blended-learning environment. *Computers & Education*, *124*, 77–91. https://doi.org/10.1016/j.compedu.2018.05.016

Alqurashi, E. (2019). Predicting student satisfaction and perceived learning within online learning environments. *Distance Education*, *40*(1), 133–148. https://doi.org/10.1080/01587919.2018.1553562

Bendridi, A. (2021). Uses of communicative and collaborative activities in e-learning: Moodle platform as a model / استخدامات الأنشطة التواصلية والتعاونية في التعليم الالكتروني: منصة Moodle نموذجا. *Ijaz Arabi Journal of Arabic Learning*, *4*(2). https://doi.org/10.18860/ijazarabi.v4i2.10923

Bower, M. (2017). *Design of technology-enhanced learning: Integrating research and practice*. Emerald Publishing Limited. https://doi.org/10.1108/9781787141827

Chin, A., Simon, G. L., Anthamatten, P., Kelsey, K. C., Crawford, B. R., & Weaver, A. J. (2020). Pandemics and the future of human-landscape interactions. *Anthropocene*, *31*, Article 100256. https://doi.org/10.1016/j.ancene.2020.100256

Cho, M.-H., & Tobias, S. (2016). Should instructors require discussion in online courses? Effects of online discussion on community of inquiry, learner time, satisfaction, and achievement. *The International Review of Research in Open and Distributed Learning*, *17*(2), 123–140. https://doi.org/10.19173/irrodl.v17i2.2342

Dahlstrom, E., D. Christopher Brooks, & Bichsel, J. (2014). *The current ecosystem of learning management systems in higher education: Student, Faculty, and IT Perspectives*. EDUCAUSE. https://doi.org/10.13140/RG.2.1.3751.6005

Elbourhamy, D. M., Najmi, A. H., & Elfeky, A. I. M. (2023). Students' performance in interactive environments: An intelligent model. *PeerJ Computer Science*, *9*, e1348. https://doi.org/10.7717/peerj-cs.1348

Fadieieva, L., & Semerikov, S. (2024). Exploring the interplay of Moodle tools and student learning outcomes: a composite-based structural equation modelling approach. In E. Faure, Y. Tryus, T. Vartiainen, O. Danchenko, M. Bondarenko, C. Bazilo, & G. Zaspa (Eds), *Information Technology for Education, Science, and Technics* (Vol. 222, pp. 418–435). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-71804-5_28

Gamage, S. H. P. W., Ayres, J. R., & Behrend, M. B. (2022). A systematic review on trends in using Moodle for teaching and learning. *International Journal of STEM Education*, *9*(1), 9. https://doi.org/10.1186/s40594-021-00323-x

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, *2*(2–3), 87–105. https://doi.org/10.1016/S1096-7516(00)00016-6

Garrison, D. R., Anderson, T., & Archer, W. (2010). The first decade of the community of inquiry framework: A retrospective. *The Internet and Higher Education*, *13*(1–2), 5–9. https://doi.org/10.1016/j.iheduc.2009.10.003

Gray, J. A., & DiLoreto, M. (2016). The effects of student engagement, student satisfaction, and perceived learning in online learning environments. *International Journal of Educational Leadership Preparation, 11*(1), 1–20. https://files.eric.ed.gov/fulltext/EJ1103654.pdf

Hamid, S., Waycott, J., Kurnia, S., & Chang, S. (2015). Understanding students' perceptions of the benefits of online social networking use for teaching and learning. *The Internet and Higher Education*, *26*, 1–9. https://doi.org/10.1016/j.iheduc.2015.02.004

Hrastinski, S. (2009). A theory of online learning as online participation. *Computers & Education*, *52*(1), 78–82. https://doi.org/10.1016/j.compedu.2008.06.009

Iberahim, N. A., & Sulaiman, N. A. (2023). An Investigation on Students-Instructors' Interaction in Online Learning Environment: A Survey among ESL Students. *International Journal of Academic Research in Business and Social Sciences*, *13*(5), Pages 1395-1403. https://doi.org/10.6007/IJARBSS/v13-i5/17155

Junco, R. (2012). The relationship between frequency of Facebook use, participation in Facebook activities, and student engagement. *Computers & Education*, *58*(1), 162–171. https://doi.org/10.1016/j.compedu.2011.08.004

Kakasevski, G., Mihajlov, M., Arsenovski, S., & Chungurski, S. (2008). Evaluating usability in learning management system moodle. *ITI 2008 - 30th International Conference on Information Technology Interfaces*, 613–618. https://doi.org/10.1109/ITI.2008.4588480

Kebritchi, M., Lipschuetz, A., & Santiague, L. (2017). Issues and challenges for teaching successful online courses in higher education: A literature review. *Journal of Educational Technology Systems*, *46*(1), 4–29. https://doi.org/10.1177/0047239516661713

Korsah, D. P. (2024). Adoption and utilization of Moodle learning management system for emergency remote teaching: A UTAUT perspective. *Educational Point*, *1*(2), e111. https://doi.org/10.71176/edup/15730

Kumar, V., & Sharma, D. (2016). Creating collaborative and convenient learning environment using cloud-based Moodle LMS: an instructor and administrator perspective. *International Journal of Web-Based Learning and Teaching Technologies*, *11*(1), 35–50. https://doi.org/10.4018/IJWLTT.2016010103

Lavidas, K., Papadakis, S., Filippidi, A., Karachristos, C., Misirli, A., Tzavara, A., Komis, V., & Karacapilidis, N. (2023). Predicting the Behavioral Intention of Greek University Faculty

Members to Use Moodle. *Sustainability*, *15*(7), Article 6290. https://doi.org/10.3390/su15076290

Manca, S., & Ranieri, M. (2016). "Yes for sharing, no for teaching!": Social Media in academic practices. *The Internet and Higher Education*, *29*, 63–74. https://doi.org/10.1016/j.iheduc.2015.12.004

Manca, S., & Ranieri, M. (2016b). Facebook and the others. Potentials and obstacles of Social Media for teaching in higher education. *Computers & Education*, *95*, 216–230. https://doi.org/10.1016/j.compedu.2016.01.012

Martin, F., Wang, C., & Sadaf, A. (2018). Student perception of helpfulness of facilitation strategies that enhance instructor presence, connectedness, engagement and learning in online courses. *The Internet and Higher Education*, *37*, 52–65. https://doi.org/10.1016/j.iheduc.2018.01.003

Maulana, N. R., & Lintangsari, A. P. (2021). The use of Moodle in English language learning during the pandemic: the students' voice. *The Journal of English Literacy Education: The Teaching and Learning of English as a Foreign Language*, *8*(1), 27–41. https://doi.org/10.36706/jele.v8i1.14020

Mayer, R. E. (Ed.). (2014). *The Cambridge handbook of multimedia learning (2nd ed.)* Cambridge University Press. https://doi.org/10.1017/CBO9781139547369

Meziane Cherif, K. (2025a). Temporal patterns and educational use of smartphones among Algerian secondary learners. *Educational Technology Quarterly, 2025*(3), 291-307. https://doi.org/10.55056/etq.956

Meziane Cherif, K. (2025a). The impact of interactive multimedia on young learners' achievement and academic behaviour in the classroom in the context of student-centred learning. *CTE Workshop Proceedings, 12,* 176-184. https://doi.org/10.55056/cte.779

Mohd Nasir, F. D., Hussain, M. A. M., Mohamed, H., Mohd Mokhtar, M. A., & Abdul Karim, N. (2021). Student Satisfaction in Using a Learning Management System (LMS) for Blended Learning Courses for Tertiary Education. *Asian Journal of University Education*, *17*(4), 442. https://doi.org/10.24191/ajue.v17i4.16225

Moore, M. G. (1989). Editorial: Three types of interaction. *American Journal of Distance Education*, *3*(2), 1–7. https://doi.org/10.1080/08923648909526659

Peramunugamage, A., Ratnayake, U. W., Karunanayaka, S. P., & Jayawardena, C. L. (2024). Design of Moodle-based collaborative learning activities to enhance student interactions. *Asian Association of Open Universities Journal*, *19*(1), 37–54. https://doi.org/10.1108/AAOUJ-06-2023-0079

Prokopenko, O. (2023). Experience of implementing e-learning to support the educational process in EU countries during the COVID-19 pandemic: A bibliometric review. E-*Learning Innovations Journal, 1*(1), 55–70. https://doi.org/10.57125/ELIJ.2023.03.25.03

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online University Teaching During and After the Covid-19 Crisis: Refocusing Teacher Presence and Learning Activity. *Postdigital Science and Education*, *2*(3), 923–945. https://doi.org/10.1007/s42438-020-00155-y

Sapriati, A., Rahayu, U., Kismiati, D. A., & Zakirman, Z. (2024). Interaction patterns in online/distance learning at higher education: A case study of biology education. *Jurnal Cakrawala Pendidikan*, *43*(3), 645–658. https://doi.org/10.21831/cp.v43i3.69951

Semerikov, S. O., Nechypurenko, P. P., Vakaliuk, T. A., Mintii, I. S., & Fadieieva, L. O. (2025a). Multivariate analysis of Moodle components and grade distribution patterns for adaptive learning environments. *Discover Education*, *5*(1), Article 15. https://doi.org/10.1007/s44217-025-01024-1

Semerikov, S. O., Nechypurenko, P. P., Vakaliuk, T. A., Mintii, I. S., & Fadieieva, L. O. (2025b). Differential effects of Moodle course design on student subpopulations: Advancing personalized learning in higher education. *Smart Learning Environments*, *12*(1), Article 46. https://doi.org/10.1186/s40561-025-00400-6

Sibgatullina, A., Ivanova, R., & Yushchik, E. (2022). Moodle learning system as an effective tool for implementing the innovation policy of the university: *International Journal of Web-Based Learning and Teaching Technologies*, *17*(1), 1–12. https://doi.org/10.4018/IJWLTT.298683

Simpson, O. (2013). *Supporting students in online, open and distance learning (2nd ed.)*. Routledge. https://doi.org/10.4324/9780203095737

Song, L., Singleton, E. S., Hill, J. R., & Koh, M. H. (2004). Improving online learning: Student perceptions of useful and challenging characteristics. *The Internet and Higher Education*, *7*(1), 59–70. https://doi.org/10.1016/j.iheduc.2003.11.003

Suad, A., Tapalova, O., Berestova, A., & Vlasova, S. (2023). The impact of Moodle learning analytics on students' performance and motivation. *International Journal of Instruction*, *16*(4), 297-312. https://doi.org/10.29333/iji.2023.16418a

Swan, K. (2001). Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. *Distance Education*, *22*(2), 306–331. https://doi.org/10.1080/0158791010220208

Tibingana-Ahimbisibwe, B., Willis, S., Catherall, S., Butler, F., & Harrison, R. (2022). A systematic review of peer-assisted learning in fully online higher education distance learning

programmes. *Open Learning: The Journal of Open, Distance and e-Learning*, *37*(3), 251–272. https://doi.org/10.1080/02680513.2020.1758651

Weidlich, J., & Bastiaens, T. J. (2018). Technology matters – the impact of transactional distance on satisfaction in online distance learning. *The International Review of Research in Open and Distributed Learning*, *19*(3). https://doi.org/10.19173/irrodl.v19i3.3417

Yusuf, N., Al-Madah, R. A. N. D. A., & Alam, M. Z. (2016). Social media as a tool in learning and social behaviour in Saudi Arabia. *International Journal of Higher Education Management*, *3*(1), 64-74. https://www.ijhem.com/cdn/article_file/i-5_c-42.pdf