Do Learning Management System Activities in Online Pedagogical Education Significantly Predict Academic Performance?

Mustafa Enes Işıkgöz
Mardin Artuklu University
School of Physical Education and Sports, Turkey
m.enesisikgoz@gmail.com
Orcid: 0000-0001-7804-1011

Abstract
In online learning as a form of distance education, "Learning Management Systems (LMS)" have become one of the most dynamic forms of higher education today. LMS components play an important role in assessing both the quality of online educational offerings and student performance. The focus of this study is whether LMS activities significantly predict student academic performance in online pedagogical education. The participants of the study consisted of 511 prospective physical education teachers taking pedagogical online education via LMS in the spring semester of 2022-2023 at a state college in Turkey. The study data consisted of the participants' learning activity assessments via LMS and their academic performance at the end of the semester. The learning activity scores were obtained from the LMS student tracking report and the end-of-semester academic performance scores were obtained from the college's "Student Information System (SIS)". The results of this study, in which correlation and hierarchical linear regression analyzes were conducted, showed that each online learning activity significantly predicted academic performance. The relative order of importance of learning activities on academic performance was found to be "number of course document downloads," "asynchronous course viewing time," "course video viewing time," and "synchronous course participation time." While the number of course document downloads alone explained 36% of the variation in academic performance scores, this variation increased to 41% with synchronous course participation time, 52% with asynchronous course viewing time, and finally 68% with course video viewing time. Although each LMS activity had a positive effect on academic performance, following lessons from downloaded documents, asynchronous lesson viewing, and video viewing were found to rank first in increasing academic performance, while synchronous course participation ranked last. Consequently, asynchronous LMS activities have a stronger impact on students' academic performance in online learning.
Keywords: Online learning activities; LMS, Pedagogical formation education; Synchronous and Asynchronous learning

Introduction

Distance education and open learning, which emerged as an interdisciplinary field in recent human history, provide learners with new learning opportunities (Bozkurt, 2019). Distance education, which has gained prominence, especially with Covid 19, continues to expand its scope and form thanks to the convenience of new technologies (Chang et al., 2015; Liu et al., 2019). Open and distance learning have attracted the attention of educators and educational researchers around the world and are widely used in many universities because they provide students with flexible access to education and reduce educational costs (Abuzant et al., 2021; Allen & Seaman, 2017; Bonk & Graham, 2012; Taplin et al., 2013; Young, 2011). Distance education is instruction in which instructors and learners are independent of time and space (Keegan, 2013). Open and distance education are defined as the acquisition of knowledge and skills through information and communication technologies, including all technologies and other forms of distance learning (Roblyer & Edwards, 2018). There are various types of distance education. However, this study focuses on online learning as a subtype of distance education.

Online learning, used interchangeably with terms such as e-learning, virtual learning, and distance education (Singh & Thurman, 2019), is defined as the use of an instructional strategy in which all educational content is delivered remotely using technology (Kauffman (2015)). Online learning is classified into three types: synchronous, asynchronous, and hybrid, depending on whether the interaction between the student and the instructor occurs simultaneously. Synchronous learning is defined as learning in real time where a group of people participate in learning at the same time, while asynchronous learning means working separately at different times and using pre-recorded lessons (Watts, 2016). Hybrid learning is a blended form of learning that combines face-to-face and online distance learning, which allows the use of methods and approaches that meet the changing needs of learners (Osguthorpe & Graham, 2003). Online learning provides a very broad learning environment for the delivery of educational content through technology and is considered a time- and cost-efficient method (Rosen, 2009). Although online learning is a relatively new approach, it is as effective as classroom learning (Murphy et al., 2020). On the other hand, while online learning technologies offer great potential for student engagement, they may be different from on-campus and face-to-face learning (Robinson & Hullinger, 2008).

Nowadays there are many learning management systems (LMS) where online learning is realized: Adobe Connect, Advancity Perculus, Bigbluebutton, Blackboard, Edgenuity, Google Classroom, Microsoft Team, Moodle, Perculus, Zoom, etc. LMS is defined as an online community that provides students with access to web-based

resources and allows educators to manage, monitor, and access student information (İzmirli & İzmirli, 2020; Kehrwald & Parker, 2019; Wilans & Seary, 2011). LMS includes many technological resources such as document sharing, synchronous and asynchronous course monitoring, homework, discussions, forums, audio podcasts, videos, various simulators, and online exams, as well as receiving reports on all these student activities (Masalimova, et al., 2022). Planning and creating learning content in digital environments, monitoring the process, maintaining student records, and conducting assessment processes are among the main functions of LMS. LMS is an important element of higher education that enables a high level of interaction between learners and instructors beyond course management and content creation (Yueh & Hsu, 2008).

As with face-to-face learning, one of the most important features that determine the success of online learning is assessment and evaluation activities (Phipps & Merisotis, 2000). Although there are different classifications, assessment in open and distance learning is generally conducted for training purposes during learning activities and for evaluation purposes at the end of learning activities (Karadağ, 2016). Measurement and assessment practices are also performed in LMS used for planning, subject content presentation, etc. In the educational environment (Bombe, 2020). Since there is no compulsion to use paper and pencil in error-based online learning, it has become easier to assess (Singh, 2019). Depending on the learning purpose and situation, online learning activities in LMS are generally: Viewing or downloading course documents uploaded to the system, reading e-books, watching synchronous lectures live or after the fact, tracking uploaded audiovisual materials related to the course, uploading homework, participating in chats and discussion forums, taking exams to test or assess success, etc. (Hrastinski, 2009; Lebenicnik et al., 2015; Shih et al., 2019). In online learning, the responsibility for teaching and learning success lies with the student and the instructor (Franklin, & Harrington, 2019). Sun (2014) identifies the main characteristics of successful learners in online learning as: individual motivation, organization of individual learning, and management of individual learning. Students' motivation to learn online and their willingness and ability to organize and manage their individual learning will naturally enhance their academic success. This is because academic success is the ability of students to remember the facts and information they have learned and to reproduce that information orally or in writing under any conditions, including exam conditions (Kpolovie et al., 2014). For students to achieve academic success, they must individualize the learning process in the LMS and self-assess by monitoring themselves (Zimmerman, 1989). Research on how learning activities in LMSs support student achievement has shown that student use of LMSs and student achievement are directly proportional and that LMS use provides consistent information about learner achievement (Bradley, 2021; Fritz, 2011; Nasser et al., 2011).

Student e-learning experiences in higher education institutions are typically integrated with academic experiences to promote sustained learning, as they are relevant not only to academic success but also to personal success and lifelong learning (Kim et al., 2019). One of the methods to ensure the quality of e-learning is to use independent e-learning behavioral data to predict learning performance through real-time monitoring and feedbacks during the learning process (Qiu et al., 2022). The purpose of this study is to investigate whether learning activities in the LMS predict the academic performance of a group of prospective physical education teachers pursuing online pedagogical education. The study focused on whether there was a linear relationship between online learning activities and academic performance outcomes rather than success or failure. Consistent with this goal, the study sought to answer the question: do learning activities in the LMS (synchronous and asynchronous attendance time in the course, number of document downloads, viewing time of course videos) significantly predict participants' academic performance outcomes? The question was attempted to answer.

Method

This study, which investigates whether some learning activities in LMS predict the academic performance of prospective physical education teachers pursuing online pedagogical education, was designed using the relational inquiry model. The participants of the study were a total of 511 prospective physical education teachers, 276 (54.0%) males and 235 (46.0%) females, who were pursuing online pedagogical education in the LMS of a state college in Turkey during the spring semester of 2022-2023. Participants took four courses in pedagogical education: introduction to pedagogy, psychology of pedagogy, principles and methods of teaching, counseling, and special education. Data for the study consisted of the activities participants completed in the LMS for these four courses and the academic performance grades they received in these courses at the end of the semester. Data on student learning activities in the LMS were taken from the Student Tracking Report. According to the Student Tracking Report, the average number of course documents uploaded to the system was (M = 67.07, SD = 32.62), the average number of synchronous lectures (h/min.) was (M = 17.30, SD = 2.81), the average number of asynchronous lectures (h/min.) was (M = 11.97, SD = 8.48), and the average number of lecture videos (h/min.) was (M = 6.09, SD = 3.78). Participants' academic performance was obtained from the college"s “Student Information System (SIS)". End-of-semester academic performance scores were calculated from 20% of the midterm exam and 80% of the final exam. Accordingly, the mean score of participants' academic performance at the end of the semester was (M = 65.19, SD = 18.40). The descriptive statistical results of the data are shown in Table 1.

Table 1. Descriptive statistics of the data

Variable	N	Min.	Max.	*M*	*SD*
LMS activities					
Number of document downloads (num.)	511	20.00	201.00	67.07	32.62
Time of synchronous participation in classes (hrs/min.)	511	11.00	32.89	17.30	2.81
Asynchronous class participation time (hrs/min.)	511	4.04	44.41	11.97	8.48
Time to watch course videos (hrs/min.).	511	0.12	17.44	6.09	3.78
Academic performance scores	511	6.00	100.00	65.19	18.40

Prior to analyzing the data, the assumptions that must be met for the analyzes were each reviewed. In the first stage, it was determined that no data were missing from the data set and that the sample size (511≥ 50+32) was sufficient according to the equation (N ≥ 50 + 8m). The second stage tested whether the data set met the normality assumption. The test showed that the skewness and kurtosis coefficients of the data were not between ±1.5 and did not have a normal distribution. Therefore, the test was repeated by logarithmically transforming the data. As a result of the logarithmic transformation, the skewness coefficients of the data were between -0.07 and 1.11 and the kurtosis coefficients were between -0.37 and -1.06, indicating a normal distribution. In the third stage, the Mahalanobis distance, Cook distance, and centered leverage were used to check if there were any outliers in the data set. It was found that there were no outliers above the critical chi-square value for the Mahalanobis distance (13.277, p <. 001) and the Cook's D. value was .07 (< 1.0). In the fourth stage, we checked whether there was a multicollinearity problem between the variables in the data set. As a result of the control, variance inflation factor (VIF) values were found to be between 1.03 and 1.52 (VIF < 4). In addition, the result of the DurbinWatson test was calculated to be 1.772. The obtained values indicate that there is no multicollinearity problem in the data set. In addition, the value of the Durbin-Watson test (DW=2.01) was found to be between acceptable limits (1.50 and 2.50) and there is no autocorrelation problem between the residuals of the independent variables (Field, 2009; Tabachnick vd., 2019). Once the statistical assumptions required for the analyzes were met, correlation and hierarchical linear regression analyzes were initiated. Analyzes were performed using the SPSS 27 package program.

Results

The results of the Pearson correlation analysis between the activity scores of the 511 participants who constitute the study sample and their academic achievement scores in the online pedagogical training courses via the LMS are presented in Table 2. According to the correlation coefficients; r= .60, p <.00 between the academic achievement scores of the participants at the end of the semester and the number of documents they downloaded for course 1, between synchronous class participation and r= .41, p < .01, between asynchronous class participation and r= .69, p < .01, between time spent watching course videos and r= .44, p < .01. In addition, the pairwise correlations between the independent variables ranged from .11 to .54, indicating that there was no multicollinearity problem (r < .80) between the independent variables.

Table 2. Descriptive statistic and corelations for study variable (n=151)

Variable	*M*	*SD*	1	2	3	4	5
1. Academic performance scores	65.19	18.40	1				
2. Number of document downloads	1.78	0.21	.60**	1			
3. Synchronous class participation time (h/min.)	4.19	0.06	.41**	.39**	1		
4. Asynchronous class participation time (h/min.)	3.94	0.28	.69**	.54**	.40**	1	
5. Time to watch course videos (h/min.).	3.52	0.37	.44**	.18**	.11	.11*	1

*p < .05 **p < .01

Hierarchical linear regression analysis was used to determine the extent to which participants' activity scores on the LMS predicted their academic performance. According to the results of the analysis, each online learning activity significantly predicted academic performance scores, and the relative order of importance was as follows: Number of downloads of course materials (β= .60, p < .001), asynchronous viewing time of lectures (β= .47, p < .001), viewing time of lecture videos (β= .35, p <.001), and synchronous attendance time (β= .24, p < .001). The variable of number of downloads of course materials, which alone entered the hierarchical model in the first step, accounted for 36% of the academic performance scores (R^2= .36, F(1, 509)= 284.39, p < .001), and the variable of synchronous attendance time at lectures, which entered the model in the second step, accounted for 41% of the academic performance scores (R^2= .41, F(2, 508)= 175.26, p <. 001), in the third step, the variable for asynchronous attendance time, which was included in the model along with both variables, together explained 52% of the academic achievement scores (R^2= .52, F(3, 507)= 210.75, p < .001), and in the fourth step, all variables together explained 68% of the academic achievement scores (R^2= .68, F(4, 506)= 257.86, p < .001). The results of the analysis can be found in Table 3.

Table 3. Results of hierarchical regression analysis for academic achievement scores

Variable	B	95% CI for B		SE B	β	R^2	ΔR^2
		LL	*UL*				
Step 1						.35	.36***
Constant	-29.55***	-40.66	-18.44	5.66			
Number of document downloads	53.28***	47.07	59.48	3.16	.60***		
Step 2						.41	.41***
Constant	-305.17***	-388.64	-221.70	42.49			
Number of document downloads	46.15***	39.81	52.49	3.23	.52***		
Synchronous class participation time	68.85***	48.17	89.52	10.53	.24***		
Step 3						.55	.52***
Constant	-248.01***	-320.99	-175.03	37.15			
Number of document downloads	27.02***	20.80	33.25	3.17	.30***		
Synchronous class participation time	34.50***	15.80	53.19	9.52	.12***		
Asynchronous class participation time	30.66***	26.00	35.32	2.37	.47***		
Step 4						.67	.68***
Constant	-323.64***	-387.44	-259.84	32.47			
Number of document downloads	21.60***	16.18	27.02	2.76	.24***		
Synchronous class participation time	41.08***	24.96	57.20	8.21	.14***		
Asynchronous class participation time	29.74***	25.73	33.76	2.04	.46***		
Time to watch course videos	17.44***	14.87	20.01	1.31	.35***		

****p < .001.*

Discussion

This study examined the predictive power of LMS activities on the academic performance of a group of prospective physical education teachers who were completing online pedagogical training. The study found positive and moderately significant relationships between participants' academic performance and the number of documents downloaded, synchronous attendance time, asynchronous attendance time, asynchronous attendance time, and time spent watching course videos in the LMS. In the hierarchical linear regression analysis, the relationship between each online activity and academic achievement scores was linear, and according to this relationship, the LMS activities together explained 68% of the change in academic achievement scores. According to the results, although each LMS activity had a positive effect on academic performance scores, it is noteworthy that following lectures from downloaded documents and then watching asynchronous and lecture videos ranked first in academic performance scores, while attending lectures synchronously ranked last.

The focus of this study is not whether each learning activity in the LMS predicts academic performance outcomes, but whether all activities as a whole predict academic performance outcomes. There are many studies in the literature (Alshorman & Bawaneh, 2018; Cenka et al, 2022; Eltayar et al, 2023; Fernandez et al, 2022; Gunawan et al., 2023; Han & Shin, 2016; Kim et al, 2019; Loderer et al, 2020; Ojeda-Castro et al, 2017; Osabutey et al, 2022; Shaame et al, 2020; Tezer & Çimşir, 2018; Widodo et al, 2021; Zainuddin & Perera, 2018). Furqon et al. (2023) reported that LMS use positively affects students' academic achievement and promotes a positive perception of LMS implementation in education. Bulut et al. (2023) found in their study that features extracted from online formative assessments (e.g., completion, timestamps, and points) were strong and important predictors of students' final course performance. Whitmer (2013) also observed a systematic relationship between student academic performance and LMS use. He found that students who used LMS more frequently received better grades than others and that this relationship explained 23% of the variation in final course grades.

These findings, drawn from the literature, relate to LMS use overall and overlap with our research findings. In addition, there are other research findings that support our research findings regarding the impact of individual learning activities on academic performance in LMSs. Kokoç and Altun (2021) investigated the impact of students' interaction with learning boards on academic performance in an e-learning environment and found that access to learning content, books, forums, and course activities can significantly affect learning outcomes. Zheng et al. (2020) reported that there is a positive relationship between the number of students' logins to the LMS system and final grades, while Shen et al. (2020) found that learners' video completion rates in e-learning influence their learning. Offir and Bezalel (2008) argue that students perform highly in online learning because they overcome the transactional nature of asynchronous learning, and Watts (2016) argues that asynchronous learning allows students to think more deeply and evaluate course materials. Similarly, Roth et al. (2020) found that distance learning delivered exclusively via videoconferencing (synchronous) leads to low course satisfaction and consequently poor academic grades.

In the study, online learning activities in the LMS explained 68% of the change in academic achievement scores, while 32% of the change in academic achievement scores indicated the presence of other unexplained factors. Barkand (2017) argues that there is no significant difference between students' academic achievement and their level of use of online platforms. This is because online learning platforms require certain knowledge and skills.

Kauffman (2015) states that students' prior background and experience, as well as learning techniques, influence their success in online courses, while Dan & Golan (2013) argue that online learning, despite its evolution, is probably not for every student. Krishnamurthy (2020) found that online learners perform marginally better than students in traditional classrooms, but that blended learning approaches may be more efficient. In addition, student performance in online learning is strongly associated with sociodemographic characteristics such as regional differences, socioeconomic status, education level, age, gender, and disability (Rizvi et al., 2019). These findings of the studies can be considered as other unexplained factors for academic performance outcomes.

Conclusion

In parallel with technological developments, online learning has become a major trend in higher education today. The delivery and management of online learning and assessment in higher education is done through institutional LMSs, which are considered lifelines (Veluvali & Surisetti, 2022). Learning analytics, especially in the online learning environment, is increasingly being used by researchers in education because it helps make standardized and measurable decisions about student performance (Kew & Tasir, 2022). It is important to examine the multiple components of LMS, both in assessing the quality and success of online learning and in determining student academic performance. Predicting student performance in online learning will improve the quality of e-learning by reducing the risk of students failing future exams and helping instructors adjust teaching methods for students who are struggling (Qiu et al., 2022). Based on this understanding, this study found that learning activities in the LMS significantly predicted the academic performance of a group of prospective physical education teachers who received online pedagogical training. It is believed that this study supports the findings of other previous studies and demonstrates an analytic relationship between academic achievement and LMS activities in online pedagogical education and will guide future researchers.

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