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Faculty Usage Patterns of Learning Management Systems in Distance Education

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Abstract: There are studies in the learning management literature examining the measure of system usage, but few explore how users apply the software tools to achieve specific work tasks, which in turn leads to perceived benefits. In the context of distance education, this study focuses on how Learning Management Systems (LMS) are fully used by faculty for their instructional needs. It extends existing research on LMS adoption by investigating how faculty members or instructors use the LMS tools for effective class teaching to achieve educational outcomes. Four usage patterns were identified: communication, content management, assessment, and class management. A model is presented to examine how these usage patterns interplay to achieve the perceived benefits. Data were collected from 544 instructors using LMS, such as Blackboard Learn, etc. Structural equation modeling using LISREL was employed to assess the research model. The results suggest that the usage for communication, content, and assessment activities positively impacts the usage for class management. In turn, the usage for class management influences the net benefits perceived by the instructors, and the usage for content also impacts perceived net benefits directly. These results provide practical guidelines for LMS developers' design improvements and institutions' policies, such as training instructors to fully utilize LMS features to achieve the maximum benefits of distance education.

Keywords: *Class management, distance education, faculty perspective, learning management systems, perceived benefits.*

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Introduction

The methods of delivery in learning have grown from traditional in-class learning environments to flexible online education environments that use Learning Management Systems (LMS), such as Canvas, Blackboard Learn, Moodle, etc. LMS are now a primary tool across educational institutions from primary to the post-secondary level that have become 'mainstream' domestically and internationally (Balkaya & Akkucuk, 2021; Gamede et al., 2022; Sulaiman, 2024). The widespread of the World Wide Web across the globe, acceptance of digital technology, and continuous sophistication of the LMS have supported the extensive growth of online distance education classes (Rosário & Dias, 2022).

During the COVID-19 pandemic, widespread lockdowns and quarantine measures prompted an unprecedented shift to remote learning across all levels of education. Subsequently, many higher education students found LMS as a valuable and advantageous tool for learning (Alturki & Aldraiweesh, 2021; Camilleri & Camilleri, 2022). Academic leaders also reported numerous benefits, such as online learning increasing access to education for underrepresented and non-traditional student populations (Laufer et al., 2021). These experiences have led to a lasting shift in the higher education landscape, with the percentage of students in 4-year institutions enrolled in distance learning classes having increased to 53% in fall 2022 from 36% in fall 2018 (National Center for Education Statistics, 2019, 2023). LMS is at the center of this transformation, which highlights the importance of understanding how faculty can best utilize LMS for student learning.

With web-based technologies, LMS allow instructors to develop and deliver the class contents (such as chapter outlines, presentation slides, videos, etc.), monitor student participation styles, and assess overall students' performance online (Sanga, 2016). Online learning gives the instructors and students various benefits that in-class learning environments

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cannot offer. For example, remote learning provides flexibility regarding the time, place, and schedule of learning (Huang et al., 2011; Islam, 2015; Kelly et al., 2010). LMS can also enable instructors to personalize learning to each student's learning style (Mustafa, 2021).

Online learning environments have been studied from several perspectives: learning benchmarks, learning opportunities, learning styles, learning outcomes, cost-benefit analysis, community building, and others. Many of these studies are anecdotal, qualitative, and/or simply isolated case studies (Edward et al., 2018; Korsah, 2024; Reid, 2019; Rhode et al., 2017). Moreover, the majority focus on the effect of using LMS on student achievement, collaboration, and support rather than the faculty perspective (Altinpulluk & Kesim, 2021; Korsah, 2024).

Prior studies assume that faculty, as facilitators of learning, are adept at integrating LMS tools into their teaching practices. The studies overlook the variability in technological proficiency among the faculty members and the challenges the faculty members may face in adapting to digital platforms. LMS includes several tools for instructors that enable content development, discussion management, group work and class participation, communications, student studying, and student tracking (Blackboard, n.d.; Moodle, 2024). How instructors utilize these tools to achieve the full benefits of distance learning (DL) still needs to be explored.

DeLone and McLean (2003) suggest that researchers should consider the nature and appropriateness of the system's use. The nature of the system's use could be measured based on whether or not the full functionality embedded in the system is used for the intended purpose. Previous research mainly addresses the time of use, frequency of use, number of accesses, or intention to use (Al-Mamary, 2022; Chen & Cui, 2020; Mandalapu et al., 2022; Shayan et al., 2023). However, none of these factors could help properly explore the relationship between how users engage in the system and the realization of expected objectives.

Understanding faculty engagement with LMS requires an approach beyond simple adoption metrics, such as login frequency or content uploads, to assess how these platforms are utilized for specific teaching purposes. Examining faculty usage patterns of LMS from a structural perspective enables a deeper understanding of how the usage of different LMS features interacts to influence perceived benefits. A pure behavioral analysis that focuses on individual choices is less likely to provide broader insights into how faculty engagement with LMS features impacts perceived benefits. By adopting a structural perspective, this study will more effectively inform policy and design improvements that support meaningful faculty engagement with LMS platforms.

In conclusion, while student perspectives on LMS usage in distance education have been studied, there is a need to explore faculty experiences with LMS further. Such research is necessary to develop effective LMS platforms and institutional strategies that enable faculty and students to take full advantage of the benefits of distance education.

Literature Review

Conceptual Development

One area has emerged with a fruitful approach to evaluating the success of Information Systems (IS). In their seminal article, DeLone and McLean (D&M) (1992) introduce an IS success model that includes information quality, use, system quality, user satisfaction, and individual and organizational impacts. In 2003, they updated their overall model to further include service quality. They also combined organizational and individual impacts into 'net benefits' (see Figure 1).

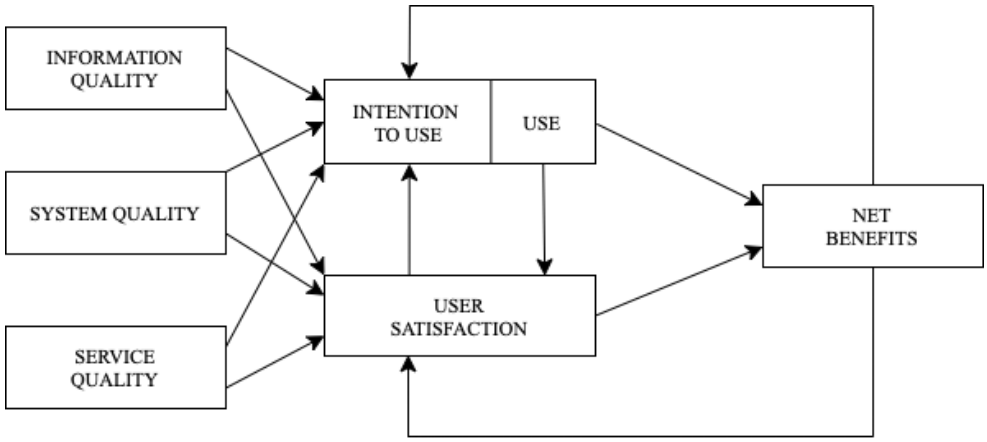

Figure 1. Updated D&M IS Success Model

Davis's (1989) classic Technology Acceptance Model (TAM) is an alternative model that focuses on predicting user acceptance of technology based on two primary constructs: perceived usefulness and perceived ease of use. These two perceptions directly influence users' attitudes toward technology use, which subsequently affects their behavioral intentions and actual usage. While TAM effectively explains individual adoption behavior, it may not fully capture how

users activate the functions and tools provided by the system. On the other hand, D&M's IS success model provides more detailed insights into how users utilize specific system features to support usage objectives. For the process of system use and its impacts, DeLone and McLean (1992) argue that users experience the features by using the system. The use of the system then influences or impacts users in the conduct of their work. Subsequent research generally supported the overall model, but almost no studies have validated the 'use' construct – how IS users use the systems to accomplish work tasks.

Since its development over three decades ago, the D&M IS success model has remained a valuable framework for evaluating the success of online platforms (Alotaibi & Alshahrani, 2022; Alzahrani et al., 2019; Urbach & Müller, 2012; Widyaningrum et al., 2024). The D&M IS success model's ability to evaluate the quality of system design, the relevance and accuracy of information provided, and the effectiveness of support services is valuable for investigating how LMS provides benefits for faculty. This is particularly important in DL, where LMS is the primary mode of instructional delivery, communication, and assessment. By measuring system success beyond basic adoption metrics, the model enables researchers to identify how faculty interact with specific features of LMS to achieve instructional benefits. Orlikowski (1992, 2000) argues how people interact with information technology (IT) and, in their ongoing practice, enact the system's structure, which shapes the situated and emergent use of IT. Application of IT is not embedded in the system but through human interaction; users shape the IT structure that shapes their use. Thus, IT will shape the usage process through human interaction. Orlikowski's theory of technological structuring emphasizes that technology is not merely an external tool but is shaped by and simultaneously shapes human action within an institutional context. In distance education, instructors' use of LMS is influenced by existing institutional policies, pedagogical norms, and personal teaching philosophies. In turn, their interactions with LMS features—such as discussion boards, assessment tools, and content management—reinforce or alter these structures over time. This recursive relationship highlights the dual role of LMS platforms as both enablers and constraints, depending on how faculty engage with them. In online teaching, faculty appropriate the tools in the LMS to achieve learning objectives. During the online course design and teaching process, faculty-system interaction is mandatory. Once instructors know that interactions will have a significant influence, they will perceive the usefulness of the benefits of the system (DeLone & McLean, 1992; Doll et al., 1995; Parlangeli et al., 1999).

DeLone and McLean (1992) find a problem with the overly simplistic definition of ' system use', which should be a complex variable. In response to DeLone and McLean (1992), our study develops an instrument to measure the 'system use' construct in the distance learning (DL) context; we posit that the usage patterns can be further delineated into four broad dimensions: communication, content, assessment, and class management, based on the Feature Guide of LMS such as Blackboard Learn (Blackboard, n.d.; Moodle, 2024). By creating an instrument to measure how faculty fully apply LMS functionalities to these four dimensions of their teaching, our study aims to explain the various mechanisms through which instructors utilize LMS to achieve their teaching goals. We also explore the interplay among these four dimensions and their relationships to system outcomes.

A significant challenge to realizing the maximum benefits of distance education is understanding how instructors fully use the LMS tools for effective class teaching and to achieve ideal educational outcomes (Laufer et al., 2021). Illustrating the relationship between faculty usage patterns and perceived benefits from using LMS can show how various LMS functionalities may improve faculty teaching and student learning outcomes, leading to higher user satisfaction and net benefits.

Based on the Blackboard and other LMS websites (Blackboard, n.d.; Moodle, 2024), LMS functionality can be classified into four categories: communication, content, assessment, and class management.

Communication

Within online learning, the instructor and students may be geographically dispersed. For effective learning, online teaching requires appropriate opportunities and methodology for students to interact with instructors and each other (Maki & Maki, 2007). Using the LMS communication tools effectively is important to clearly establish learning objectives, course expectations, and grading criteria (Topal, 2016). Discussion boards, online forums, class roster emails, and/or chat rooms allow constant communication and interaction with the instructor and other students to facilitate a deeper understanding of the course content and assignment guidelines (Alturki & Aldraiweesh, 2021). Instructors can also provide further opportunities for communication by posting information for accessing virtual office hours via Zoom, Google Meets, or Microsoft Teams on the LMS (Lowenthal et al., 2017). This study defines communication as the extent to which LMS enables active faculty-student and student-student interactions.

Content

Previous studies reveal that content quality significantly impacts student satisfaction (Alterkait & Alduaij, 2024; Koh & Kan, 2020; Limbu & Pham, 2023). With improved content quality, users generally find the software more useful and quickly assimilate to it. Designing and delivering content is different in the online environment. Instructors are expected to provide high-quality content for their students in the form of course notes, presentation slides, video recordings,

rubrics, and more (Camilleri & Camilleri, 2022). PDF files of textbook chapters or case studies, videos explaining course content, animations that illustrate course concepts, web pages linking to external resources, and graphics/images that aid learning are all examples of content tools that an instructor can use in the LMS. Moreover, e-learning content is designed to be delineable, reusable, expandable, and shareable. For this study, we define content as the extent to which the technology is used to design, develop, and deliver online course materials.

Assessment

Effective assessment techniques can enhance the entire e-learning experience (Winstone et al., 2020). Assessment literacy is the ability to effectively use assessment tools provided within the LMS to evaluate the knowledge and skills of students in online classes (Romero et al., 2015). LMS provides instructors with many assessment formats for students, such as multiple-choice problems, short-answer and essay questions, homework assignments, interactive labs and case studies, and self-assessing learning modules. Instructors can also directly communicate grades and individualized feedback to students through the LMS (Rhode et al., 2017). For this study, we define assessment as the extent to which DL instructors use technology to assess student understanding and mastery of the course material.

Class Management

Managing the e-learning classroom is a challenge for both novice and experienced online instructors (Eisenman et al., 2015; Merrett & Wheldall, 1993). LMS tools can help instructors develop their class management skills while enhancing the overall e-learning experience for students. Examples of LMS functions that allow instructors to check user progress and behavior include the number of logins to the LMS, completion status of required class assignments, time spent on exams/quizzes, click-ins to videos and other supportive materials, calculations of grades for assessments, and other opportunities. These indicators of student engagement are a valuable tool for instructors to find ways to maximize student learning. For example, minimal logins, not clicking on important course materials and a short amount of time spent on assessments are signs of low student engagement that can help instructors identify students with a higher risk of attrition (Kittur et al., 2021). For this study, class management is defined as the extent to which LMS is used to track student participation and progress.

Research Model and Hypotheses Development

Research Model

This research first operationalizes the use metrics proposed by DeLone and McLean (1992, 2003) to include communication, content, assessment, and class management. The research then investigates how these usage patterns lead to perceived benefits from the instructors' perspective. Figure 2 shows the research model, which explores the extent to which the LMS were fully used for faculty's instructional needs in terms of communication, content management, assessment, and class management, leading to net benefits. Table 1 provides the definition of each variable and related literature.

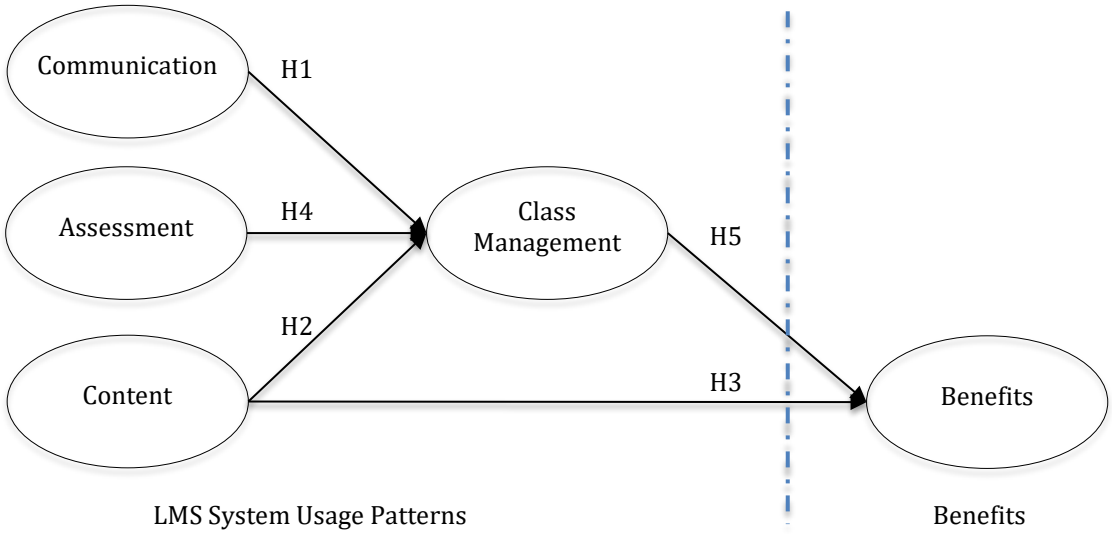

Figure 2. Research Model

Table 1. Constructs Definitions

Construct	Definition	Literature
Communication	The extent to which technology allows the active interaction between faculty and students and among students.	Quinney (2005); Littlefield and Roberson (2005); Weil and Rosen (1997); Bradley (2021)
Content	The extent to which the technology is used to design, develop, and deliver online course materials.	Al-Fudail and Mellar (2008); Camilleri and Camilleri (2022)
Assessment	The extent to which the technology is used to assess student understanding and mastery of the course material.	Goldsmith (2007); Winstone et al. (2020)
Class Management	The extent to which the learning management system is used to track student participation and progress.	Chickering and Gamson (1987); Kittur et al. (2021)
Benefits	The influence that the application exerts on individual work.	Doll and Torkzadeh (1988); Orlikowski (1992); Laufer et al. (2021)

Communication and Class Management

The foundation for all types of learning is communication via face-to-face interaction or technological transfers (Salas & Cannon-Bowers, 2001; Salas et al., 2002; Singh et al., 2021). Online teaching is a challenge; instructors must develop techniques and strategies to enhance student engagement in discussions and other enriching online opportunities (Alturki & Aldraiweesh, 2021). Using discussion boards, announcements/news, and/or emails, instructors can explain class expectations, how assessments will be handled, how discussion forums will be assessed, how individual students will be graded in group assignments, remind students of assignments deadlines, assign students to project groups, report expectations, and more (Rhode et al., 2017). Students can also ask and discuss questions on discussion boards or work on group projects in private forums. As students communicate more often with their instructor, the instructor knows more about their participation in the class and also their learning about the course materials. The more students communicate with other students via LMS, the more the information is shared. The instructor will be able to track their participation in the discussions or the progress of their learning or assignments. Thus, we propose:

H1: Communication has a positive effect on class management in the DL environment.

Content and Class Management

For distance education, LMS is used to deliver course materials online. Course content shapes how teaching and learning are delivered and how the content is understood and applied. The online content delivered through LMS must be highly usable for both the students and instructors alike. Contents, such as presented in multimedia, audio/video clips, animations, pictures, graphics, and others, help accomplish the objectives of learning (Camilleri & Camilleri, 2022; Chang, 2003). Once the contents have been posted online, the instructors may track the students' activities in reviewing different types of materials. These activities may help provide an indication about the appropriate design and delivery of course content that could motivate students to spend more time with the course content and make their learning experience more positive and effective (Garrels & Zemliansky, 2022). The appropriated design and delivery of the course content, based on the observations of students' online activities, may help better cater to students' learning styles (Amiri et al., 2024). For this study, it is hypothesized that:

H2: Content has positive effects on class management in the DL environment.

Content and Benefits

Desplaces et al. (2015) identified high-quality course materials as another key component of a student's success. LMS enables instructors to provide learning materials from different sources in a variety of formats. For example, instructors can include external resources in the form of educational videos, online articles, interactive labs, and/or case studies through the LMS. The high-quality and easy-to-understand materials will help enhance student learning (Ismail et al., 2021). LMS can help the instructors prepare or re-use different types of contents and deliver them to students quickly and with convenience. These functions in LMS help increase the instructors' productivity and their perceived teaching effectiveness. Thus, we contend:

H3: Content management has positive effects on faculty benefits in the DL environment.

Assessment and Class Management

Through constructive feedback, effective assessment techniques enable students to fully understand their learning and the objectives they are studying for (Elwood & Klenowski, 2002). With the goal of continuous improvement, assessment is important for the development of learners' engagement in the DL environment (Beebe et al., 2010). The assessment strategies send signals to students regarding how they should approach studying and what is important (Garrison, 2011;

Vonderwell & Boboc, 2013). Adequate feedback, utilizing the many tools available in LMS, can improve achievement, enhance student engagement, and foster motivation to learn (Feng et al., 2025; Lee & Recker, 2021). Instructor assessment behavior, such as collaborative work, project-based learning, and self-assessment, is critical for online teaching and leads to a greater engagement of students in the evaluation of their progress and own work overtime (Herrera-Pavo, 2021; Yan & Carless, 2022; Yuliansyah & Ayu, 2021). Furthermore, understanding student engagement through assessment opportunities can help instructors identify ways to improve student learning (Bulut et al., 2023). Thus, we propose:

H4: Assessment has positive effects on class management in the DL environment.

Class Management and Benefits

One challenging task of the instructor is to establish an environment conducive to student learning. By checking a student's login record, stage of content accomplished, and performance on the assignments, faculty can monitor the student's learning progress and ensure the student's success. Furthermore, these signs of student engagement enable faculty to preemptively identify and assist students struggling with course material, thereby decreasing the likelihood that students will fall behind or drop out of the class (Kittur et al., 2021). Lower engagement with certain content items is also a form of student feedback that can assist instructors with course design. In addition, the class management tools provided by LMS help faculty deal with large class sizes and enhance the productivity of online teaching. For these reasons, we propose:

H5: Class management has positive effects on faculty benefits in the DL environment.

Methodology

Sample and Data Collection

This research analyzed the relationship between usage patterns and faculty-perceived benefit. Usage patterns have four sub-constructs. We analyzed the relationship among these four sub-constructs with faculty-perceived benefit by collecting data from seven universities in a Midwestern state of the United States using an online SurveyMonkey questionnaire. The survey was sponsored by the Distance and eLearning Divisions of every institution, and the link to the online questionnaire was sent to 3467 instructors who used LMS for class teaching. 554 faculty completed the survey, and respondents represented 11 separate disciplines including 26.4% from Arts and Humanities, 12.3% from Social Sciences, 11.9% from Business Administration, 10.8% from Education, 9.2% from Engineering, 8.7% from Health and Human Services, and 8.5% from Physical Sciences. The sample's distribution of the disciplines approximately matched the size of each university's respective program, indicating that no particular discipline was over- or under-represented.

Instruments

To measure how faculty use LMS for online education, we developed an item pool to measure communication, content, assessment, and class management based on Blackboard and other LMS software functions and features (Blackboard, n.d.; Moodle, 2024). The instrument for measuring faculty perceived benefits was derived from research on work productivity and system success literature (DeLone & McLean, 2003; Sharda et al., 2004). The items used in the sample of 554 respondents are illustrated below in Table 2.

Analyzing of Data

This paper followed a two-step approach to estimate the measurement model before examining the full structural model (Anderson & Gerbing, 1982, 1988). A two-step approach has more advantages than a one-step approach; a two-step approach allows the testing of the significance of all coefficients, allows assessment of acceptable structural model fit, and testing one allows to make an asymptotically independent test of the substantive or theoretical model of interest (Anderson & Gerbing, 1988). The statistical package LISREL was used for the assessment of the measurement and the structural models. The first step is to estimate the measurement model, and the second step is to estimate the structural model. The measurement model specifies the relationship of the observed measurement items and the constructs that are inter-correlated. The structural model specifies the path or the causal relationships based on the underlying theory (Anderson & Gerbing, 1982). The estimators with the maximum likelihood approach are unbiased, consistent, and efficient in large sample sizes (Kmenta, 1971). Anderson and Gerbing (1988) noted that small sample sizes may generate (1) too large standard errors to draw meaningful conclusions about parameter estimates or (2) a greater chance of a Type II error for parameter estimates. Harris and Schaubroeck (1990) suggest 100 as a minimum sample size but recommend at least 200.

Table 2 reports the constructs and their measurement items, the description of each item, the standardized item-factor loading, and the construct's composite reliability. The values of the item-factor loading are between .68 and .97, all above the acceptable value of .5 (Hair et al., 1998). The values of the composite factor reliability are between .81 and .92, all greater than the acceptable values of .70 (Nunnally, 1978).

Table 2. Items of Usage Patterns (Communication, Content, Assessment, and Class Management) and Perceived Benefits, Cronbach Alpha, and Factor Loading

Constructs	Items	Standardized item factor loadings	Composite factor reliability
A: Usage Patterns			
1. Communication	I use this software to help		.91
Com1	me coordinate student groups.	.75	
Com2	students communicate with each other.	.91	
Com3	students collaborate with each other.	.95	
2. Content	I use this software to		.81
Cnt1	deliver online course content.	.76	
Cnt2	reuse the course content.	.68	
Cnt3	create online course content.	.85	
3. Assessment	I use this software to		.92
Amt1	assess my students' understanding of the course material.	.97	
Amt2	assess my students' mastery of the course material.	.96	
Amt3	help students take self-tests.	.72	
4. Class Management	I use this software to		.90
Clm1	help students track the status of their assignments.	.87	
Clm2	help students track progress.	.94	
B. Benefits			.88
Ben1	In general, this software enhances my teaching effectiveness.	.92	
Ben2	The software improves my productivity.	.76	
Ben3	This software improves my students' learning.	.83	

Discriminant validity between constructs/factors was assessed by performing a chi-square test on the different values obtained from the two models: one with the estimated correlation between the two factors constrained to 1 and the other unconstrained (Joreskog, 1971). For the practical significance of the test, the setting should be pairwise, with one pair of factors at one time rather than simultaneous tests of all pairs of interest (Hair et al., 1998; Joreskog, 1971).

Table 3 reports the results of pair-wise tests of discriminant validity. For ten pairs of tests, the chi-square difference per degree of freedom between the constrained and the unconstrained models should be greater than 7.88 for significance at p-value < .05 and 10.83 at p-value < .01 (Cohen & Cohen, 1983). A significant large chi-square difference per degree of freedom provides evidence that traits are not perfectly correlated and that discriminant validity between the constructs is evidenced (Joreskog, 1971). All the chi-square differences per degree of freedom are greater than 10.83 for a significant level at the p-value < .01, suggesting that the measurement model with five factors has achieved high discriminant validity.

*Table 3. Pair-Wise Discriminant Validity (** p value < .01)*

Pair-wise discriminant validity	Chi-Square (df)			Significant
	Unconstraint	Constraint	Differences	
Communication – Content	15.74 (8)	430.40 (9)	414.66 (1)	**
Communication – Assessment	24.33 (8)	981.28 (9)	956.95 (1)	**
Communication – Class Management	4.83 (4)	364.86 (5)	360.03 (1)	**
Communication – Benefits	24.78 (8)	780.90 (9)	756.12 (1)	**
Content – Assessment	27.89 (8)	375.66 (9)	347.77 (1)	**
Content – Class Management	5.47 (4)	434.38 (5)	428.91 (1)	**
Content – Benefits	27.05 (8)	398.01 (9)	370.96 (1)	**
Assessment – Class Management	7.43 (4)	346.08 (5)	338.65 (1)	**
Assessment – Benefits	23.21 (8)	768.48 (9)	745.27 (1)	**
Class Management – Benefits	5.97 (4)	746.13 (5)	740.16 (1)	**

The model-data fit of the measurement model was assessed with chi-square, degree of freedom, the ratio of chi-square to degrees of freedom, root mean square error of approximation (RMSEA), non-normed fit index (NNFI), and the comparative fit index (CFI) (Bentler, 1990; Bentler & Bonett, 1980; Chau, 1997; Joreskog & Sorbom, 1993;Steiger, 1989). Good-fitting models generally yield the ratio of chi-square to degrees of freedom of less than 3.0 (Chau, 1997), RMSEA of less than 0.05 (Steiger, 1989), and NNFI and CFI fit indexes of at least .90 (Bentler & Bonett, 1980; Bollen, 1989). The values of the NNFI and CFI are less sensitive to the sample size.

The measurement model yields $\chi 2 = 156.12$, df = 67, $\chi 2/df = 2.33$, RMSEA = 0.049, NNFI = .99, and CFI = .99. All the values are within the range of the accepted ones, indicating that a good data-model fit exists in the measurement model.

We observed the cross-loading and correlated error terms for the measurement model. Sethi and King (1994) indicate that the existence of error correlation between items should be modified if the value has a substantial impact on the model. The measurement model suggested two cross-loadings, item Ben3 on construct Communication at 14.23 (expected changes index = .11) and Ben3 on Content at 12.47 (expected changes index = .13), and two correlated errors with indices above 10 between item Com1 and item Amt3 at 10.45 (expected changes index = .13) and between Cnt2 and Amt3 at 19.46 (expected changes index = .19). The expected changes of the cross-loadings are much smaller than the standardized loading of item Ben3 on its intended construct Benefits at .83. The suggested modification indices and the expected changes of the correlated errors are relatively small and do not substantially impact on the factor loading. We, thus, concluded that the items do not need to be removed from the measurement model, and we can continue to assess the structural model.

Findings

The hypotheses in the research model were assessed with structural equation modeling (SEM). The complete structural model is based on usage pattern constructs and the perceived faculty benefits. The assessment of the model-data fit employed the same set of criteria as those used for the measurement model. The structural model yields $\chi 2 = 156.75$, df = 69, $\chi 2/df = 2.27$, RMSEA = 0.048, NNFI = .99, and CFI = .99. All the values are within the range of the accepted ones, indicating a satisfactory structural model for further hypothesis testing.

Table 4 reports the results of the five hypotheses. The relationship between communication and class management is significant at a *p*-value < .05 (path coefficient = .10 and *t*-value = 2.12). Hypothesis 1 is, thus, supported. This result indicates that, in the DL context, the more the instructors use the LMS to enhance the interactions between the instructor and the students and among the students, the more the instructors use the LMS to manage the class, that is, to track students' participation and progress. The relationship between content management and class management is significant at *p*-value < .01 (path coefficient = .19 and *t*-value = 3.29). Hypothesis 2 is supported, suggesting that the more instructors use the LMS to design, develop, and deliver course materials online, the more instructors use the LMS to track students' participation and progress. Hypothesis 3 is supported. The relationship between content management and the faculty benefits is significant at p-value < .001 with a path coefficient is .40 and its t-value is 8.03, suggesting that the more the instructors use LMS to design, develop, and deliver course materials online, the more they perceive personal productivity, teaching effectiveness, and the students' learning brought about by LMS. Hypothesis 4 is supported. The relationship between assessment and class management is significant at *p*-value < .001 with a .36 path coefficient and a 6.56 *t*-value. The result indicates that the more the instructors use the LMS for assessing students' understanding and mastery of the course materials, the more the instructors use the LMS to monitor the students' participation and progress. Hypothesis 5 is supported by the significant relationship (*p*-value < .001) between class management and faculty benefits, with its path coefficient of .27 and its t-value of 5.77. The more the instructors use the LMS to track students' participation and progress, the more the instructors perceive the benefits enhanced by the LMS in terms of the instructors' productivity, teaching effectiveness, and the students' learning.

Table 4. Summary of the Hypotheses Test Results for Structural Model

Hypothesis	Path	Path Coefficient	T-Value	Supported
H1	User Communication–Class Management	.10	2.12	Yes*
H2	Content Management–Class Management	.19	3.29	Yes**
H3	Content Management–Faculty Benefit	.40	8.05	Yes***
H4	Assessment–Class Management	.36	6.56	Yes***
H5	Class Management–Faculty Benefit	.27	5.77	Yes***

*: p-value < .05; **: p-value < .01; ***: p-value < .001

Discussion

For knowledge workers to achieve the work task, system use is mandatory, but the continued appropriateness of the system itself is still voluntary. Notably, it can be argued that declining utilization of basic features of the system may be an important indication that the expected benefits are not being achieved (DeLone & McLean, 2003). All five hypotheses generated by the interactions between and among the research model's components are supported by the dataset. The results indicate that usage patterns have substantial effects on perceived faculty benefits.

In the DL environment, robust communication positively influences class management. Bradley (2021) contended that as instructors use online forums, discussion boards, and class roster emails to a greater extent, higher levels of interaction are achieved between the instructor and students and among students themselves. With clear and direct communication using the available LMS tools, instructors can communicate the expectations and requirements of the class; this helps students engage and participate in the online classroom environment. A higher level of student-to-student

communication also allows students to assist each other with understanding course material and assignment expectations, thereby enabling greater instructor productivity.

Content influences teaching and learning effectiveness through the quality, format, and re-use of the content mixture options available on the LMS. We found that the enriched content management behavior has a direct impact on both class management and perceived net benefits. Furthermore, content management has the strongest impact on perceived faculty benefits across the proposed model. The results are consistent with that of El-Sabagh (2021): the more instructors employ a variety of content types through videos, animation, graphics, audio clips, and web-based texts, the more students are involved in the online classroom learning experience, thereby achieving higher levels of learning objectives.

The more instructors use assessment tools, such as homework and online quizzes, and give prompt and appropriate feedback, the more students understand their class performance and what they need to do to be successful in the online class. The findings are consistent with those of Winstone et al. (2020) in that detailed and timely feedback allows students to focus their studying on areas in need of improvement and gives them more time to prepare for future assignments and assessments.

The study shows that assessment, communication, and content management all contribute positively to efficient class management. The more faculty use LMS tracking tools to monitor students' login records, clicks on course materials, and the amount of time spent in LMS, the more likely it is that faculty will perceive the system as beneficial to teaching and learning. These tools provide instructors with valuable insights regarding how students engage with the course through the time and frequency of their interactions with course materials and assessments (Kittur et al., 2021).

The findings of this study can guide universities in identifying gaps in faculty engagement and addressing barriers that hinder the effective use of LMS. Universities can increase faculty engagement with LMS through institutional interventions, such as training and technical support programs. For instance, institutions can implement mandatory LMS training workshops that teach faculty how to effectively utilize LMS communication, content, assessment, and class management features to support instructional objectives. Technical support services, including peer mentoring and instructional design assistance, can further improve faculty experiences with LMS by reducing frustration and improving confidence in using digital tools. By leveraging these findings, universities can create a distance education environment where faculty use LMS platforms effectively to enhance teaching and student learning outcomes.

While all hypotheses are supported, the significant levels of the coefficients vary from 0.05 for communication to 0.01 for content management and to 0.001 for assessment. The sample size of 554 exceeds the minimum requirement of 200. However, the findings should still be interpreted with caution for Type II errors and be cross-verified with other samples. From the perspective of LMS design, system developers may focus their efforts more on the features that help enhance content management or assessment than communication. From the perspective of faculty training, faculty members may be more likely to learn how to assess student learning or manage the material content than how to enable communication mechanisms to effectively manage distance learning classes.

Conclusion

In this research, we tested a model of usage patterns of LMS from the faculty perspective, examining not only the relationships between the communication, class management, content management, assessment, and online teaching benefits factors but also the path relationship for the whole model. The results support all five hypotheses. This study found that communication affects class management, and content management affects both class management and faculty benefits. We also found that assessment affects class management, and class management affects faculty-perceived benefits. This study suggests that content development in LMS and its impact on class management and faculty benefit is the key to successful distance education. The results suggest that fruitful areas of future research may include not only IS theory but also elements of socio-technical theory (Von Bertalanffy, 1950) and structuration theory (Orlikowski, 1992, 2000). Structuration theory (Orlikowski, 1992, 2000) suggests that the relationship between the human actor and technology is a combination of both the confines of structure and the emergent quality of use that occurs as the tools are applied and manipulated in the organizational work context.

Recommendations

This paper shows that the 'use' in DeLone and McLean's (2003) model can be operationalized along four dimensions that reflect how the instructors interact with the tools and capabilities of the LMS. The instruments can be used to evaluate how the four usage patterns interact with each other as they are related to effective class management and how they help create perceived benefits in the DL context.

The potential of advances in technology to further student learning and broaden access to education highlights the importance of understanding how instructors can reap the most significant advantages from online learning (Firat, 2023). This study offers multiple practical implications for faculty, higher education institutions, and LMS developers. The tools for providing content, communication, and assessment are of particular importance for effective class

management. Among these four, content has the most substantial impact on class management and the most direct influence on benefits.

To enhance faculty adoption and effective utilization of LMS, universities and LMS developers should implement targeted policy interventions that address common barriers to engagement. One concrete strategy is the establishment of mandatory LMS training workshops for new and existing faculty, ensuring they acquire the necessary technical and pedagogical skills to optimize LMS functionalities. In order to achieve the maximum benefits of online teaching, these workshops should be structured to train instructors to understand how to use LMS features and their potential use cases related to these four factors.

In practice, the IT support division of universities should organize training workshops for faculty who teach online courses. Such workshops should teach instructors how to utilize a variety of content types to aid student learning, facilitate and foster student-instructor and student-student communication through discussion boards and chat rooms, and implement various assessment formats that provide students with thorough and timely feedback for their learning. By helping faculty recognize and interpret indicators of student engagement, such as student login records and time spent on content and assessments, these training workshops can also help instructors design engaging online courses and identify students struggling with class material.

This information is valuable to LMS developers as well. The LMS should be designed to help instructors enact the functions of communication, content, assessment, and class management in an intuitive and user-friendly manner. Offering a variety of tools for communication, content, and assessment gives instructors greater freedom to design an online course that matches their teaching style and course material. Furthermore, LMS developers should implement accessible tools for monitoring student course activity and progress to aid instructors with class management. These factors provide a framework for LMS developers to ensure that new tools and/or changes to existing features enable faculty to realize the greatest benefits.

Future research should explore faculty adoption of LMS platforms through qualitative approaches, such as in-depth interviews and focus group studies, to uncover nuanced insights into faculty experiences, challenges, and attitudes regarding LMS. Furthermore, longitudinal studies tracking faculty LMS usage patterns over time could offer valuable insights into the long-term impact of institutional interventions. Such studies could examine whether initial training and support efforts lead to sustained engagement or whether faculty usage of LMS changes over time.

Limitations

This study has several limitations. Firstly, the findings are based on a dataset with 554 faculty members teaching distance learning courses at different academic institutions in the Midwest region of the United States, indicating that the general applicability of the findings to broader faculty populations in other regions or international contexts is limited. For example, faculty in developing countries may face greater technological and infrastructural constraints, such as limited internet connectivity, inadequate training opportunities, or differing pedagogical cultures, all of which could result in varying usage patterns of LMS that differ from the Midwest region of the United States. On the contrary, faculty in regions with stronger governmental investments in digital education, such as parts of Europe or East Asia, may exhibit more extensive uses of LMS features for a greater variety of teaching purposes. To enhance general applicability, future research should consider cross-regional comparisons or incorporate diverse institutional settings to examine how geographical factors shape LMS usage among faculty. Secondly, the findings are based on self-reported data for both independent and dependent variables, which may bring in bias. Faculty members may unintentionally misrepresent their LMS adoption by either overstating their interaction with system features to align with institutional expectations or underreporting due to a lack of awareness of their own usage behaviors. To mitigate this limitation, triangulation with actual LMS usage logs can provide a more objective and comprehensive understanding of faculty engagement. By analyzing system-generated data, such as login frequency, content uploads, discussion forum activity, and the use of interactive tools, researchers can validate self-reported responses and identify discrepancies between perceived and actual LMS usage.

Ethics Statements

The studies involving human participants were reviewed and approved by the University of Toledo. The participants provided their written informed consent to participate in this study.

Generative AI Statement

This paper does not use any generative AI tools or AI-assisted technologies in writing.

Authorship Contribution Statement

J. Wang: Conceptualization, design, data acquisition, writing, supervision. Deng: Data analysis, statistical analysis, writing and revision of manuscript. D. Wang: Literature review, references, editing/reviewing, critical revision of manuscript.

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