Insights at the Nexus of Instructional Design and Student Success: An Institutional Analysis Using LMS Accessibility Metrics

Jeff Freels
Southwestern Michigan College, USA
https://orcid.org/0000-0002-3732-0871

Rajagopal Sankaranarayanan
The University of Texas at Austin, USA
https://orcid.org/0000-0003-1052-0344

Abstract

This study explores the influence of Learning Management System (LMS) course site design on student failure and withdrawal rates (DFW) in undergraduate courses in a residential hybrid educational context. We used multiple linear regression analysis to explore the interactions between course-level DFW, enrollment, student satisfaction, and counts of instructor-embedded content in LMS course sites in 925 course sections in one semester at a public research university in the southern United States. Findings suggest that optimal LMS course site design supports lower DFW rates. The findings are contextualized within the Community of Inquiry (CoI) Framework, and a case is made that certain types of instructor-embedded content in LMS course sites can serve as a measurable proxy for teaching presence. This study contributes to the discourse on the impact of digital learning environment design on student outcomes and provides actionable insights for educators aiming to design student-centered digital learning spaces.

Keywords: LMS course design, student success, hybrid learning environments

Freels, J. & Sankaranarayanan, R. (2025). Insights at the nexus of instructional design and student success: An institutional analysis using LMS accessibility metrics. *Online Learning, 29*(3), 158-175. https://doi.org.10.24059/olj.v29i3.4965

Introduction

Researchers have extensively investigated the relationship between instructional design and student success in higher education settings (Ralston-Berg & Braatz, 2021; Robertson & Doloc-Mihu, 2024; Sung & Mayer, 2012). As the internet matured, learning-management systems (LMS) emerged as the digital backbone of colleges and universities, supporting face-to-face, hybrid, and fully online instruction (Rhode et al., 2017). Most higher education institutions now integrate the LMS with their campus information systems, encourage widespread faculty adoption, and provide ongoing training and support, turning the LMS into a ubiquitous hub for content delivery, assessment, and student engagement across all course modalities.

Yet ubiquity alone does not guarantee effectiveness. When LMS course sites are poorly designed, students can experience disengagement (Heilporn et al., 2021), increased cognitive load (McGuire, 2017), and confusion about course requirements and objectives (Fayer, 2014). For some students, especially those enrolled in multiple courses with disparate design schemes (or no scheme at all), the need to navigate and adapt to those varying contexts can impose a heavy cognitive load that inhibits learning and success across their entire course load. Over time, these issues can result in diminished learning outcomes, reduced persistence, and lower overall student success, highlighting the need for well-structured and effective instructional design in digital learning environments.

In recognition of these challenges, some higher education institutions have adopted standardized LMS course site templates to promote a more uniform digital learning experience across their online offerings (Henry et al., 2008; Williams et al., 2022). In those cases, the aim is a more consistent user experience that reduces variability in LMS course site quality and guides students intuitively towards the attainment of course learning outcomes. Higher levels of student satisfaction often result as well (Watson et al., 2017). Despite the benefits of standardization, many institutions allow instructors the autonomy to design their course sites based on their personal preferences. This flexibility fosters innovation and allows educators to tailor their course sites to specific pedagogical needs, but it also leads to higher levels of variability in the quality and structure of digital learning environments.

The study described in this paper was conducted at a large public research university in the southern United States, where almost all undergraduate students live on or near campus. Courses are offered in face-to-face, hybrid, and online formats. The university has zero fully online undergraduate degree programs, and 92% or more of undergraduate course sections each semester are offered in face-to-face formats. Since 2020, however, there has been a notable shift towards increased adoption of hybrid and online course formats. This change coincides with higher student expectations for technology use in face-to-face courses. Approximately 95 to 99% of undergraduate course sections at the university have a published LMS course site each semester, which is indicative of widespread adoption of educational technology. This pervasive use of digital resources within a primarily residential setting is characteristic of a residential hybrid model of education.

In this study, we define *residential hybrid* as a higher education model where students primarily reside on or near the physical campus, engaging in regular in-person classes and activities while simultaneously engaging with a substantial portion of their academic coursework through digital learning technologies. Technology is an integral extension of a campus experience in which both online and in-person educational activities are common. The learning process is a continuous interplay between physical and digital realms. In environments like these, where academic engagement spans both physical classrooms and digital platforms, coherent and supportive instructional design is critical for maximizing student engagement and success. As such, exploring how the design of LMS course sites impacts student success in this blended learning context is both relevant and timely.

The current residential hybrid model emerged from the COVID-19 pandemic, which accelerated pre-pandemic trends towards more digitally integrated learning environments. A recent study by Guppy et al. (2022) provides an overview of these changes from a global

perspective. This multi-national research gathered insights from diverse educational stakeholders across four continents, revealing a consensus that trends towards increasing adoption of hybrid learning formats were real and would continue, which we have observed at the institution in this study.

Given the shift towards more hybrid higher education in residential contexts, there is a distinct need for research that examines how these models impact student learning and engagement. The current study enriches the academic discussion on post-pandemic higher education by addressing this gap. It serves as a practical guide for institutions aiming to refine their instructional designs to better suit a world where digital and physical learning environments are increasingly intertwined.

Purpose of the Study

This study aimed to examine the impact of various types of instructor-embedded content in LMS course sites on student withdrawal and failure rates (DFW) in university courses over a single semester. Predictor variables included numbers of announcements, assignments, files, quizzes, and a variable known as the Content Optimization Metric (COM), which was calculated based on the total number of pages in each Canvas course site. Additionally, the study controlled for the enrollment size of each course and the mean score from one item on the end-of-course student survey (ECS score) that is administered to every student near the end of every class. To this end, the following research question guided this study: *To what extent do enrollment size, end-of-course student survey scores (ECS), counts of instructor-embedded content (including announcements, assignments, files, quizzes), and COM account for variations in withdrawal and failure rates (DFW) among students in undergraduate courses in a single semester?*

Literature Review

The literature suggests that the quality of LMS course site design can directly affect student attitudes, engagement, and academic success (e.g., Baldwin, 2019; Fayer, 2014). For instance, Baldwin (2019) demonstrates how poorly structured courses can significantly hinder student engagement and lead to suboptimal learning outcomes. Similarly, Fayer (2014) presents evidence that well-designed courses enhance student satisfaction and academic achievement. As such, effective instructional design extends beyond content delivery, focusing heavily on course organization and navigability, which are crucial for fostering an effective learning environment.

Clear organizational structures, such as weekly folders and intuitive navigation paths, significantly boost student confidence and facilitate success (Larson & Lockee, 2014; Robertson & Doloc-Mihu, 2024). Moreover, employing instructional strategies such as “chunking,” which involves breaking content into smaller, manageable units, can reduce cognitive overload and enhance the learning process (McGuire, 2017; Sankaranarayanan et al., 2024).

The design and usability of LMS course sites are crucial in shaping students’ educational experiences. In hybrid courses, that design takes on added significance: consistent content organization and schedule flexibility directly determine how seamlessly a class can shift between in-person and online work, while also supporting the more active, student-centered learning role typical of hybrid environments (Álvarez-Chaves & Saborío-Taylor, 2025). Studies have shown

that LMS course sites that lack clear navigational aids often result in poor student experiences (Demmans Epp et al., 2020). Similarly, research by Sung and Mayer (2012) suggests that online courses equipped with effective signaling aids can significantly boost student performance by improving memory retention and understanding. Furthermore, several studies found a connection between the usability and aesthetic appeal of LMS course sites and improved learning outcomes and student engagement (c.f. Ralston-Berg & Braatz, 2021; Sung & Mayer, 2012). Poor organization of LMS course sites can negatively impact students' perceptions of faculty commitment, affecting motivation, satisfaction, grades, and withdrawal rates (Placencia & Muljana, 2019).

While existing literature provides a robust foundation for understanding online course design, there is a notable gap concerning hybrid learning environments, particularly in the post-COVID context. Recent scholarship points to a substantial need for research that spans various instructional contexts and modalities (Bradley, 2021; Sochor, 2022), which is especially relevant for the residential hybrid contexts in which both in-person and online educational activities are important. Few scholars emphasize the complexity of conducting research in hybrid settings, advocating for studies that are tailored to specific institutional contexts and that explore the interplay between course elements and student success (e.g., Ali & Hanna, 2022; Robertson & Doloc-Mihu, 2024).

Community of Inquiry Framework

The present study employs the Community of Inquiry (CoI) framework to disaggregate the nuances of student engagement and learning in hybrid environments. The CoI framework, which distinguishes between social, cognitive, and teaching presences as central to effective educational experiences, provides a comprehensive approach to examining online and blended learning contexts. The CoI framework is foundational for digital learning research because it provides a model for investigating how social, cognitive, and teaching presences in a course enrich student's educational experience (Garrison et al., 2000). Social presence enables the students to project their individual characteristics to cultivate a sense of connectedness in limited physical interaction settings. Cognitive presence deals with the development of critical inquiry skills necessary for deep and meaningful learning experiences in online environments. Teaching presence involves course design, facilitation, and direction for students to achieve the course learning outcomes (Smith et al., 2017). The CoI framework has evolved over time to better address the complexities of digital learning in both asynchronous and synchronous formats (Garrison et al., 2000; Cleveland-Innes, 2019).

While the CoI framework posits that its three components—social, cognitive, and teaching presences—collectively enhance online learning, some researchers note that teaching presence, as expressed through instructional design, is crucial for social and cognitive presences to flourish (Smith et al., 2017). In hybrid learning environments, where educational delivery combines online and face-to-face interactions, the design and organization of learning activities in an LMS course site can be a critical factor that contributes to or inhibits student success. Good teaching presence leads to online and in-person learning activities that are seamless and complementary (Robertson & Doloc-Mihu, 2024).

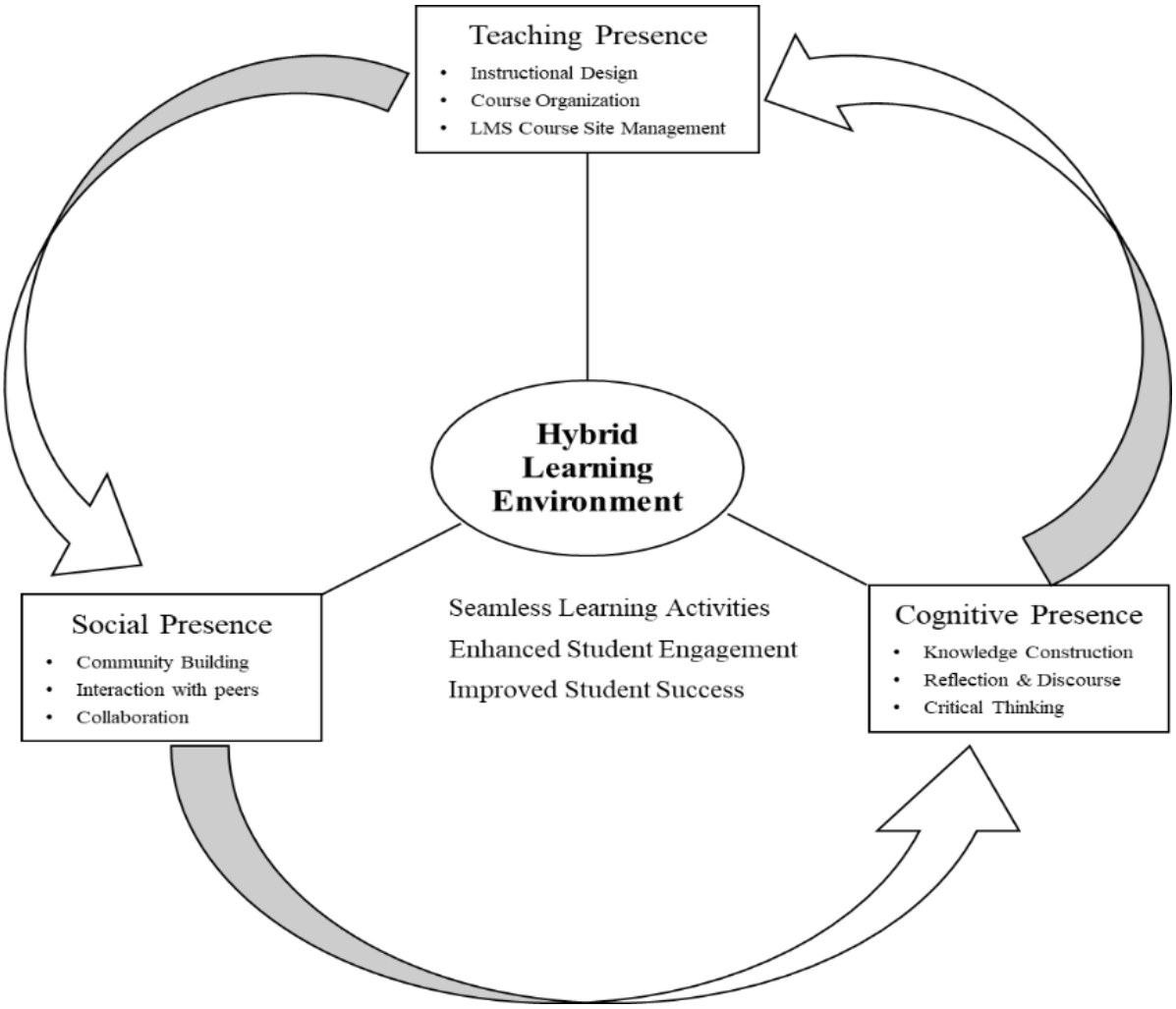
The framework provides a useful tool for scrutinizing the impact of LMS course site design on student success in hybrid courses. For the purposes of this paper, we define teaching

presence as “the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes” (Anderson et al., 2001). In digital learning environments, that includes crafting learning outcomes, curating learning materials, sequencing lessons and activities, and creating assessments and evaluation criteria, much of which should take place before the class begins. In this context, instructors who effectively organize and present course content, establish clear navigation pathways, and provide comprehensive instructions exhibit strong and effective teaching presence. Thus, LMS course site design can be seen as a tangible manifestation of teaching presence, with significant implications for student success in hybrid learning environments.

Anchored in the CoI framework, this study foregrounds teaching presence as it unfolds in residential-hybrid courses. Guided by Beatty’s (2019) HyFlex principles, we define teaching presence as the intentional orchestration of course organization, facilitation, and direct instruction inside the LMS shell. Recent scholarship shows that LMS sites with coherent content structures and flexible schedules—hallmarks of sound design—amplify student agency and engagement in hybrid settings (Álvarez-Chaves & Saborío-Taylor, 2025; Hodges & Lowenthal, 2020). Yet large-scale evidence that links objective design indicators—specifically, LMS course design features to concrete success metrics such as DFW rates is still scarce in the *Online Learning Journal* literature. To address this gap, the inquiry described in this paper seeks to consider the possibility that LMS course sites can be optimally designed to support student engagement and success. Figure 1 depicts the conceptual model guiding this inquiry, positioning optimal LMS design as the pivotal link between teaching presence and student success.

Figure 1

Community of Inquiry Framework for Hybrid Learning Environments



Methods

This section describes the study context, the study design, the measures, and the sampling procedure.

Study Context

In 2023, the university in this case study adopted Anthology Ally (Ally), an accessibility plug-in, in its Canvas LMS. Ally performs several functions, including scanning instructor-

embedded content in Canvas course sites—announcements, assignments, discussions, files, pages, syllabus, and quizzes—and determining the degree to which each is accessible, expressed as a percentage, or "accessibility score." It reports to instructors primarily to help them identify inaccessible learning materials in their LMS course sites, but it also provides counts of each type of content in every course in an institutional report available to administrators. We interpreted those counts of instructor-embedded content in LMS course sites as measurable indicators of teaching presence, the analysis of which can offer researchers a window on the intersection of design with student success.

As part of a preliminary analysis, we collected data from the Ally Institutional Report from a random sample of courses (n = 70) and merged it with additional measures. Those included data on enrollment, or the number of students who received a grade or withdrew from the course; student satisfaction, as measured by the mean result on a single item from end-of-course student surveys (ECS score); and the percentage of students who failed or withdrew from the course (DFW). Across the courses in the pilot sample, the mean student response rate on the ECS was 41% (range = 27% to 63%). Despite a relatively small sample size, a preliminary linear regression analysis suggested potential correlations between DFW and several types of instructor-created content in LMS course sites, including the number of pages, files, and quizzes. These initial findings provoked questions about the influence of LMS course site design on student success and prompted the research team to broaden the quantitative dataset and initiate qualitative research to delve deeper into these relationships.

Study Design

To answer our research question, we adopted a correlational research design (Fraenkel et al., 2023) to explore the relationship between the seven predictor variables and student outcomes, as measured by the DFW rate for each course section, or the percentage of students who withdrew or received failing grades. This approach was selected because it enables the examination of naturally occurring relationships in educational data without manipulations or controls, a typical characteristic of experimental designs (Fraenkel et al., 2023). The final dataset included data from 925 undergraduate course sections in one semester.

To be included in the sample, course sections had to have:

- One instructor and at least five students.
- A published Canvas course site with at least five files and two other types of instructor-embedded content (Announcements, Assignments, Discussions, Files, Pages, Quizzes, and Syllabus).
- Two or more D, F, or W grades or one DFW and 20 or fewer total students (5% DFW or higher).

Sampling Procedure

There were 5,002 undergraduate course sections with at least five students in the semester in which the study took place. A stratified random sample of 925 sections, representing 18.5% of the total, was selected from these 5,002 course sections through the following sampling procedure. First, all the course sections for each undergraduate college and department were listed in a Microsoft Excel file. Then, we used the Excel random number generator to select

courses from each undergraduate college randomly. The course sections in the sample varied by enrollment size, modality (online, hybrid, and face-to-face), and academic level (both lower and upper levels). Given the subject of this research, the lack of control for instructional modality could be viewed as a validity threat. However, the research team did not view this as a serious concern given that more than 92% of the university's undergraduate course sections in the semester in question were classified as face-to-face courses. It is possible that hybrid and fully online course sections were in the sample, but they would have made up a small percentage of course sections overall. In the end, the sample encompassed course sections from every undergraduate college at the university, proportionately selected based on the number of degree programs within each college. The final sample included course sections from 120 academic departments.

Measures

The primary outcome, or dependent variable, was calculated per course section as the percentage of enrolled students who earned grades of D or F or withdrew from the course (DFW). Our study analyzed several independent variables. First, enrollment included the total number of students enrolled in each course section. Second, students' overall perception of the course was quantified through the mean score on one ECS item: "Overall, the course was ….." with responses provided on a five-point Likert scale (1 = Very Unsatisfactory to 5 = Excellent); for the 925-sections in the dataset, the mean ECS response rate was 41 % (SD = 9%, range = 24% to 68%). Then, we included counts of instructor-created content, which encompassed total counts of announcements, assignments, files, and quizzes uploaded to each Canvas course site by instructors or their proxies. Finally, the COM, a categorical variable, was derived from the number of pages reported by Ally within each section's course site.

Due to the skewed distribution of values in Pages across LMS course sites (see Table 1), we transformed the number of Pages in each course section to a categorical variable called COM. This transformation addressed the highly skewed nature of the Pages data in the sample (n = 925), which showed a mean of 10.2 pages, a mode of 0, a median of 1, and a maximum of 952 pages, a problematic degree of skewness for the linear regression analysis we set out to perform. This transformation aimed to reduce skewness and more accurately reflect our hypothesized construct for instructional design effectiveness. Each course section was grouped into one of three categories of COM as shown in Table 1. The rationale for these categories was based on the hypothesis that the suboptimal course site design, as reflected in the number of pages on the site, was bimodal. In other words, we considered it likely that course sites with very few and very many pages would be the course sites in most need of improvement from the standpoint of student engagement and success.

Table 1

Course Optimization Metric (COM) Calculation

Minimum pages	Maximum pages	COM score	Sample courses
0	1	1	531
2	9	2	177
10	45	3	165
46	89	2	24
	90+	1	28

Prior research and practice suggest that course sites with little organization (such as might be found in sites with 0 or 1 pages) may provide insufficient guidance for students, potentially leading to confusion about course navigation and expectations. On the other hand, course sites with a great deal of content (such as those with 90 pages or more) may overwhelm students to the point of disengagement. This bimodal conceptualization of suboptimal course design—characterized by either a paucity or an excess of content—formed the basis for our ongoing investigation into the relationship between LMS course site design and student outcomes. COM, then, was intended to diminish the skewness of the data and to group course sections by values of Pages thought to correspond with better or worse instructional design.

Initially, we collected data on Discussions and Syllabus from Ally for each of the sample course sections but subsequently removed the variables from the study. Discussions were excluded due to the unreliability of Ally counts of this feature, which did not account for external discussion tools used by many instructors at the university. Syllabus is reported by Ally as a binary variable that indicates whether the native Canvas Syllabus tool is being used in the course section. In practice, the Syllabus section of Canvas course sites often functions as a calendar of assignments rather than a true syllabus, unless the instructor loads the syllabus in some fashion to that section of the course site. The variable does not account for syllabi loaded elsewhere in the course site either. Thus, we did not believe the Ally variable, Syllabus, was an accurate indicator of the presence of a syllabus in the course site. For these reasons, we omitted both the discussions and syllabus counts from the final dataset and subsequent analysis.

Findings

To explore the factors influencing overall failure and withdrawal rates (DFW), we conducted a series of multiple linear regression analyses using IBM SPSS Statistics Version 25. Our analysis progressed through three models to gradually include a wider range of predictor variables, each designed to predict DFW rates, quantified as the percentage of students who failed or withdrew from a course section in one semester.

The initial model incorporated counts of four types of instructor-embedded content in Canvas course sites—announcements, assignments, files, and quizzes—and a metric, COM, derived from counts of pages in Canvas course sites. The second model built upon the first by

adding enrollment size as an additional predictor to assess its impact alongside the other variables. In the third and most comprehensive model, we included all the predictors from the second model and introduced the ECS score as a predictor variable, aiming to control for the interaction between student satisfaction and grades. The standard assumptions of multiple linear regression analysis (i.e., linearity, homoskedasticity, independence of errors, normality, and independence of independent variables) were tested and sufficiently met to justify further analysis.

The first regression equation with the instructor-embedded content in Canvas course sites was found to be significant, $R2 = .015$, $F(5,919) = 2.80$, $p = .016$. The individual predictors were examined further, and the results showed that counts of some instructor-created content on Canvas sites, such as Announcements ($t = .16$, $p = .87$), Assignments ($t = 1.10$, $p = .27$), Files ($t = -1.51$, $p = .87$), and Quizzes ($t = 1.34$, $p = .18$), were not statistically significant predictors of the model. However, the model revealed a statistically significant association between COM ($t = -3.06$, $p = .02$) and DFW, suggesting that course sections with more optimal numbers of Canvas Pages were more likely to have lower DFW rates.

Enrollment was entered in the model in stage two, alongside counts of the four types of instructor-embedded content and COM. The results of this analysis indicated that COM ($t = -2.76$, $p = .006$) and enrollment size ($t = -3.03$, $p = .003$) accounted for a significant percentage of DFW rates, $R2 = .025$, $F(6,918) = 3.88$, $p = .001$, indicating that larger classes with more optimal numbers of pages tended to have lower DFW rates.

The third and final analysis was conducted to evaluate whether all seven predictors—announcements, assignments, COM, files, quizzes, enrollment size, and ECS score—were predictive of course section-level DFW rates. The multiple linear regression analysis resulted in a significant model, as indicated by an F-statistic of 10.64 with a p-value less than .001 ($F(7, 917) = 10.64$, $p < .01$), suggesting that the model explains some of the variance in DFW rates. The R2 value of .075 suggests that the model can account for approximately 7.5% of the variance in course section-level DFW rates, illustrating the included predictors' impact. In Table 2, we present our model for predicting DFW rates per course section. Five of seven bivariate correlations between the predictor variables and DFW rates (DFW) were negative, and three of the seven indices, COM ($t = -2.26$, $p = .024$), enrollment size ($t = -3.47$, $p = .001$), and ECS Score ($t = -7.07$, $p < .01$) were statistically significant ($p < .05$). These results suggest that courses with optimal numbers of Canvas pages, higher enrollment, and higher student satisfaction was associated with lower rates of course-level failure and withdrawal.

Table 2

Multiple Linear Regression Model Predicting DFW Rates

Variable	*B*	*SE*	95% CI	β	*p*
Constant	.25	.02	[0.212, 0.285]	-	< .001
Number of students	.00	.00	[0,0]	-.12	.001
Total Files	.00	.00	[0,0]	-.06	.139
Announcement	.00	.00	[0,0]	.00	.951
Assignment	.00	.04	[0,0]	.04	.217
COM	.00	.00	[-0.013, -0.001]	-.08	.024
Quiz	.00	.00	[0,0]	.06	.114
ECS Score	-.03	.00	[-0.038, -0.022]	-.23	< .001

Note. $R^2 = .075$, $F\ (7, 917) = 10.64$, $p < .001$.

Discussion and Implications

The findings from this study suggest that counts of certain types of content loaded in LMS course sites correlate with course-level DFW rates, although the effect size was not large in this case (we estimate 0.5%–1.2% fewer students with DFWs in the courses in the study sample if course site design was optimized in all of them). Our hypothesis that very small and very large numbers of Canvas Pages are suboptimal from the standpoint of student success is plausible. The correlation of our COM with course-level student success in this study suggests that educators and instructional designers should pay careful attention to the amount of content provided in their courses, as well as how it is delivered. LMS course sites can effectively host a great deal of content when they are well-organized and provide students with clear navigational and signaling aids.

We hypothesize that LMS course sites can be optimized through a learner-centered, design-driven approach. Optimally designed courses reduce the cognitive load required of students to navigate course sites, leaving them with more time and capacity to learn. This finding is well-established in prior research on student learning and success in online, asynchronous formats, but our research suggests it held for the residential hybrid students in this study. This should not be surprising in light of the degree to which many college students, especially traditionally aged cohorts (18–24), live their lives on their smartphones. Regardless of whether they attend a residential or online college or university, students today need digital learning experiences that connect to how they live. Organizing content in LMS course sites within an optimal range of material, as empirically defined, could enhance student engagement and success.

The impact of LMS course site design on student success extends beyond asynchronous online courses. While the factors influencing student performance are undoubtedly complex, recent research has highlighted the importance of effective LMS design across all modalities. For years prior, research had suggested a connection between LMS course site design and student success in fully online courses. However, the widespread adoption of digital learning tools during and after the COVID-19 pandemic has revealed that those findings are relevant to hybrid and face-to-face courses as well. Today, we have evidence that a thoughtfully constructed LMS site can enhance student engagement and success in hybrid and face-to-face courses, regardless of the course's primary mode of delivery. The CoI framework provides a structured approach to understand the implications of this phenomenon.

We argue that counts of instructor-embedded content in LMS course sites as reported by Ally represent measurable components of teaching presence as defined in the CoI framework. Only instructors or their proxies can create Canvas pages, announcements, and assignments. Students have to interact with that content to successfully complete their classes. In that context, content counts can provide an instructor-created map of the course-level digital student experience that can be analyzed for research and improvement. The number of pages in a Canvas course site is not, by itself, an important variable. Instead, it serves as a proxy for teaching presence by indicating the degree to which course instructors make their students interact with a structural component of the LMS. Given that teaching presence is likely to vary across institutional, instructional, and disciplinary contexts, the optimal range of Canvas Pages is probably different from one institution, instructor, or discipline to the next. We encourage institutional researchers and teaching and learning specialists to use our method to consider optimal design for their contexts.

Unfortunately, too few faculty members, at all types of institutions, lack training in or support for instructional design. If anything, we hope this research encourages institutions to invest in instructional design that works for students and faculty. In our opinion, that means teams of faculty members, designers, and assessment and accessibility specialists, working together to create an engaging and effective digital learning environment. After rollout, student feedback on LMS course sites should be elicited, and sites should undergo regular usability testing to iterate towards designs that better meet student needs. This is often too much for one faculty member to handle.

Study Limitations

This study offers valuable insights into online factors influencing student withdrawal and failure rates, but it also has several limitations that require careful consideration. First, although this study tested a large sample (n = 925), representing 18.5% of total courses in one semester, it was limited to courses at one university, which may affect the generalizability of the findings. We attempted to mitigate this limitation by collecting a stratified sample of courses from every undergraduate college and 120 academic departments.

Second, the study relied on a derived metric, Content Optimization Metric, or COM, that assumes a bimodal distribution of suboptimal counts of Canvas Pages as they relate to student outcomes. While useful, COM may not comprehensively capture all the nuances of course design quality. For example, the research team did not account for the substance of course content (e.g., announcements or pages that contained student-centered language), the use of

third-party tools in the course, or possible manifestations of student presence. In theory, it is possible for an LMS course site to have suboptimal numbers of pages and still be robust and student-centered. Future iterations of COM should consider more carefully those types of confounding variables.

Third, the study's cross-sectional design limits our capacity to establish causality between course design and DFW rates. A longitudinal approach would be more suitable to explore the impacts of course design changes over time.

Fourth, the statistical model accounts for only 7.5% of the variance in DFW rates, suggesting the presence of other significant but unmeasured variables that influence student success. Some of those variables are mentioned above, including the substance of course content, the use of third-party tools, evidence of student presence, such as course modality, academic level, disciplinary area, and the degree to which instructors require that students use the LMS were not considered in the present study. In the case of this study, the undergraduate course sections at the university at which this study took place are overwhelmingly offered face-to-face, which suggests that the failure to control for modality was not a significant validity threat in this case. The inclusion of course modality and these other variables could boost the effect size significantly.

Fifth, Pages data from Ally were not accurate in some cases because unpublished Canvas pages, hidden from students, were counted. This was not a problem for the 57.4% of course sites in the sample that had zero or one page, since an inaccurate count of one page would indicate a course section with zero actual Pages. Beyond that, a review of the sample suggested that page counts were off by 10% or less in most cases. We estimate that a more accurate page count would have led to a COM category change for about 5% of overall cases in the model. In all those cases, the COM value would be off the real count by one.

Sixth, the ECS data were subject to potential non-response bias: the item we analyzed had an average response rate of roughly 40%, so students with strong positive or negative opinions may be over-represented despite a sensitivity check that showed no systematic link between response rate and DFW outcomes.

Lastly, the study findings revealed that some LMS course site components—i.e., announcements, assignments, and quizzes—did not significantly predict DFW rates, which might suggest that the presence of these components is less impactful on student engagement and success. Alternatively, the methods used in this study may not have been adequate to the task of measuring the impact of announcements, assignments, and quizzes on student engagement and success.

Study Implications and Future Research Directions

This study's findings have important implications for both academic research and educational practice by providing valuable insights into how certain online factors influence student success in residential hybrid courses. Given the potential impact that optimizing LMS course sites could have on reducing DFW rates, institutions should invest in instructional teams that support faculty in building engaging, effective, and accessible LMS course sites. Those

teams should guide instructors towards simpler, well-organized LMS course sites that provide clear navigational and signaling aids that support student learning and success.

Future studies should adjust Canvas Pages counts from Ally to account for unpublished ones; control for course modality, discipline, and academic level, as the inclusion of any or all is likely to improve the overall model fit; analyze more comprehensive and reliable data from LMS course sites and the external tools integrated with them (learning tools interoperability, or LTIs) to include student engagement with the types of instructor-created content or student LTI launches; and seek a more sophisticated course design map that more accurately captures the LMS course site architecture and its interaction with student engagement, learning, and success. LMS course site maps could serve as a critical tool for course instructors, providing them with detailed information on the aspects of course design that most significantly affect student success and guiding targeted improvements in digital content delivery in learning management systems.

Given the observed impact of COM on DFW rates, future research should seek to refine and contextualize COM. As previously noted, the optimal range of Canvas Pages will vary by instructor, discipline, and institution. Faculty, institutional researchers, and instructional design staff should collaborate to experiment with LMS course site designs that seek optimization within contextually appropriate boundaries. Testing the effectiveness of different COM thresholds in varied disciplines and academic levels could provide deeper insights into how course content optimization affects learning outcomes under different instructional conditions. Future research should also integrate qualitative analysis on LMS course sites to account for the quality of content and clarity of delivery in their models.

Building on this study's findings, we are currently expanding the scope of our research in two ways. First, we are testing the model from this study with data from two different semesters with the aim of validating the current study findings. Next, we are ready to conduct qualitative evaluation of LMS course sites from a selected sample of course sections in this study using a rubric adapted from the State University of New York's Online Course Quality Review Rubric (OSCQR). Third, we plan to refine the COM to better capture the nuances of optimal design. Through these efforts, we hope to provide actionable insights that inform real enhancements in digital learning practices and further refine our understanding of how course design impacts student outcomes and engagement.

Conclusion

In conclusion, as higher education continues to evolve in response to technological advancements and changing student demographics, this study contributes valuable insights into how effectively designed LMS course sites can enhance student success. This current study has highlighted key aspects of LMS course site design and their relationships to student DFW in a residential hybrid educational setting. Our study findings indicate that while certain types of instructor-embedded content in LMS course sites do not significantly influence DFW rates, factors such as enrollment size, the COM, and ECS correlate significantly with it. The crucial role of COM in the model suggests that optimizing the amount and delivery of course content can effectively reduce the cognitive load on students, thereby enhancing their capacity to succeed. This aligns with existing literature that emphasizes the importance of thoughtful course design in improving student engagement and educational outcomes, particularly in an era where

digital interaction plays a substantial role in the educational experience of traditionally aged college students. To build on these findings, future research should extend beyond the confines of this study to include data from additional semesters and different institutions. It should also refine the use of metrics like COM to more accurately reflect the effectiveness of course design across various educational contexts. Moreover, the integration of qualitative evaluations of LMS course sites using adapted instruments like the SUNY OSCQR rubric will provide deeper insights into the qualitative aspects of course design and its impact on student success. By continuing to refine our understanding of these relationships and adapting our educational practices accordingly, we can better support students in achieving their academic goals in any learning environment.

Declaration of Competing Interest

Authors have no competing interests to declare.

References

Ali, A. D., & Hanna, W. K. (2022). Predicting students' achievement in a hybrid environment through self-regulated learning, log data, and course engagement: A data mining approach. *Journal of Educational Computing Research, 60*(4), 960–985. https://doi.org/10.1177/07356331211056178

Álvarez-Chaves, A., & Saborío-Taylor, S. (2025). Hybrid learning in higher education: Considerations for its implementation in course design. *Journal of Digital Educational Technology, 5*(1), ep2505. https://doi.org/10.30935/jdet/15859

Anderson, T., Rourke, L., Garrison, R., & Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning, 5*(2), 1–17. https://doi.org/10.24059/olj.v5i2.1875.

Baldwin, S. J. (2019). Assimilation in online course design. *American Journal of Distance Education, 33*(3), 195–211. https://doi.org/10.1080/08923647.2019.1610304

Beatty, B. J. (2019). *Hybrid-flexible course design* (1st ed.). EdTech Books. https://edtechbooks.org/hyflex

Bradley, V. M. (2021). Learning management system (LMS) use with online instruction. *International Journal of Technology in Education, 4*(1), Article 1. https://doi.org/10.46328/ijte.36

Cleveland-Innes, M. (2019). The Community of Inquiry theoretical framework. In H. Beetham & R. Sharpe (Eds.), *Rethinking pedagogy for a digital age: Designing collaborative online and blended learning* (pp. 85–101). Routledge.

Demmans Epp, C., Phirangee, K., Hewitt, J., & Perfetti, C. A. (2020). Learning management system and course influences on student actions and learning experiences. *Educational Technology Research and Development, 68*(6), 3263–3297. https://doi.org/10.1007/s11423-020-09821-1

Fayer, L. (2014). A multi-case study of student perceptions of online course design elements and success. *International Journal for the Scholarship of Teaching and Learning, 8*(1). https://doi.org/doi.org/10.20429/ijsotl.2014.080113

Fraenkel, J., Wallen, N., & Hyun, H. (2023). *How to design and evaluate research in education* (11th ed.). McGraw Hill.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *Internet and Higher Education, 2*(2–3), 87–105. https://doi.org/10.1016/S1096-7516(00)00016-6

Guppy, N., Verpoorten, D., Boud, D., Lin, L., Tai, J., & Bartolic, S. (2022). The post-COVID-19 future of digital learning in higher education: Views from educators, students, and other professionals in six countries. *British Journal of Educational Technology, 53*(6), 1750–1765. https://doi.org/10.1111/bjet.13212

Heilporn, G., Lakhal, S., & Bélisle, M. (2021). An examination of teachers' strategies to foster student engagement in blended learning in higher education. *International Journal of Educational Technology in Higher Education, 18*(1), 25. https://doi.org/10.1186/s41239-021-00260-3

Henry, B., Marcella, K.B., Kurzweil, D., & Davis, S. (2008). Using templates to build courseware to enhance ease-of-use for faculty and usability for learning. In *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2008* (pp. 87–91). http://www.editlib.org/p/29584

Hodges, C., & Lowenthal, P. (2020). Facilitating your online course: Where to focus your efforts when a course is in progress. In *Proceedings of the 2019 ICDE World Conference on Online Learning* (Vol. 1, pp. 39–50). International Council for Open and Distance Education.

Larson, M., & Lockee, B. B. (2014). *Streamlined ID: A practical guide to instructional design*. Routledge.

McGuire, B. (2017). Principles for effective asynchronous online instruction in religious studies. *Teaching Theology & Religion, 20*(1), 28–45. https://doi.org/10.1111/teth.12363

Placencia, G., & Muljana, P. (2019). The effects of online course design on student course satisfaction. In *Proceedings of the 2019 American Society for Engineering Education Pacific Southwest Section Meeting*. https://peer.asee.org/31845

Ralston-Berg, P., & Braatz, H. (2021). Online course design structure and interface. *New Directions for Adult and Continuing Education, 2021*(169), 15–33. https://doi.org/10.1002/ace.20411

Rhode, J., Richter, S., Gowen, P., Miller, T., & Wills, C. (2017). Understanding faculty use of the learning management system. *Online Learning, 21*(3), 68–86. https://doi.org/10.24059/olj.v21i3.1217

Robertson, C., & Doloc-Mihu, A. (2024). Effect of LMS course structure on student success in asynchronous online courses. In *Proceedings of the 2024 ACM Southeast Conference* (pp. 35–42). https://doi.org/10.1145/3603287.3651204

Sankaranarayanan, R., Yang, M. & Kwon, K. (2024). Exploring the role of a microlearning instructional approach in an introductory database programming course: An exploratory case study. *Journal of Computing in Higher Education*. https://doi.org/10.1007/s12528-024-09408-2

Smith, S. U., Hayes, S., & Shea, P. (2017). A critical review of the use of Wenger's Community of Practice (CoP) theoretical framework in online and blended learning research, 2000–2014, *Online Learning, 21*(1), 209–237. https://doi.org/10.24059/olj.v21i1.963

Sochor, C. J. (2022). *Student perspectives on the presence and usefulness of navigational course elements in distance education courses* [Master's thesis, Marshall University]. Marshall Digital Scholar. https://mds.marshall.edu/etd/1344

Sung, E., & Mayer, R. E. (2012). Affective impact of navigational and signaling aids to e-learning. *Computers in Human Behavior, 28*(2), 473–483. https://doi.org/10.1016/j.chb.2011.10.019

Watson, F. F., Castano Bishop, M., & Ferdinand-James, D. (2017). Instructional strategies to help online students learn: Feedback from online students. *TechTrends, 61*(5), 420–427. https://doi.org/10.1007/s11528-017-0216-y

Williams, K. N., Gombas, A. K., Cornejo Happel, C., Parodi, T. C., Lazzara, E. H., & Chaparro, B. S. (2022). A practical tool to enhance faculty and student interactions surrounding e-learning platforms. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 66(1)* (pp. 1126–1130). https://doi.org/10.1177/1071181322661397