Int. J. of AI and Education Technology

♦ ISSN: 2835-2432 Vol: 05, No. 01, 2026 ♦ PP. 43–57

Article DOI: https://doi.org/10.54216/IJAIET.050105

FULL LENGTH ARTICLE

Evaluating Microsoft Teams, Blackboard, Canvas, and Zoom for Online Teaching Effectiveness: A Multi-Dimensional Comparative Study in Higher Education

Tariq Saali[1,*] **Tassawar Kamran**[2]

[1] American University in the Emirates, UAE

[2] Global College of Engineering and Technology, Muscat, Oman

Emails: Tariq.saali@aue.ae · Tassawar@gcet.edu.com

Received: October 28, 2025 Revised: December 03, 2025 Accepted: January 10, 2026 ⋆ Corresponding author

ABSTRACT

The rapid institutionalisation of online and hybrid delivery models in higher education has left instructors and academic administrators managing a fragmented landscape of dedicated learning management systems, video conferencing platforms, and collaborative productivity suites that overlap substantially in function but differ markedly in pedagogical affordance. Selecting a platform or combination of platforms is consequential for instructor workload, student engagement, and learning outcomes, yet the evidence base for such decisions remains limited to narrow single-platform evaluations or anecdotal comparisons. This paper presents a systematic multi-dimensional comparative evaluation of four widely adopted platforms—Microsoft Teams, Blackboard, Canvas, and Zoom—drawing on original survey data from 284 instructors and 642 students across five higher education institutions. Nine evaluation dimensions are examined: content delivery, real-time collaboration, assessment and feedback, usability, technical reliability, student engagement support, accessibility, analytics and reporting, and third-party integration. Quantitative analyses include one-way analysis of variance across all nine dimensions, Bonferroni post-hoc comparisons, Pearson correlation analysis, and multiple regression modelling of the predictors of instructor overall satisfaction. Canvas achieves the highest composite scores for usability, analytics, and integration; Blackboard leads on assessment and reporting depth; Microsoft Teams leads on real-time collaboration; and Zoom leads on content delivery in synchronous sessions but performs poorly on the asynchronous dimensions where dedicated learning management systems are strongest. The paper synthesises findings into a platform selection framework and eight evidence-based recommendations for practitioners designing or evaluating technology-enhanced teaching environments.

Keywords: Learning management systems ▪ Microsoft Teams ▪ Blackboard ▪ Canvas ▪ Zoom ▪ Online teaching effectiveness ▪ Educational technology evaluation ▪ Student engagement ▪ Higher education

1. INTRODUCTION

The COVID-19 pandemic forced a mass experiment in online higher education that would under normal circumstances have taken a decade to materialise. Between March 2020 and August 2021, virtually every higher education institution (HEI) worldwide moved its instructional delivery to remote or hybrid formats, deploying or accelerating the adoption of video conferencing tools, learning management systems (LMS), and integrated collaboration suites [1, 2]. Post-pandemic, the majority of HEIs have retained significant online or hybrid provision, not as a contingency but as a deliberate pedagogi-

cal model. The platforms adopted during this period were not always chosen for educational fitness; many were adopted for speed of deployment, existing site licences, or staff familiarity [3, 4].

Four platforms dominate institutional deployment globally in 2025: Microsoft Teams, Blackboard (now Anthology), Canvas (Instructure), and Zoom. Each occupies a distinct position in the platform landscape. Canvas and Blackboard are purpose-built learning management systems with comprehensive course delivery, assessment, gradebook, and analytics functionality. Microsoft Teams is a productivity and collaboration suite that has been extended for educational use and integrates closely with the Microsoft 365 ecosystem. Zoom is a video conferencing platform adopted predominantly for synchronous session delivery and widely cited for its simplicity and reliability, but structurally limited in asynchronous and assessment functionality [5, 6].

The pedagogical differences between these platforms are not merely technical. The choice of platform determines whether instructors can provide timely formative feedback, whether students can access content flexibly, whether assessment integrity mechanisms are available, and whether interaction data can be aggregated for learning analytics. These dimensions map onto well-established frameworks for educational technology acceptance and success [7, 8, 9, 10], yet systematic comparative evidence across all four platforms using a unified evaluation instrument remains absent from the literature.

The present study addresses this gap through a large-scale mixed-methods evaluation of the four platforms across nine instructional dimensions, informed by the Technology Acceptance Model [7], the DeLone and McLean IS Success Model [11], and the Community of Inquiry framework [12]. The specific contributions are:

- A nine-dimension evaluation framework for online teaching platforms, grounded in the pedagogical affordances literature and operationalised into a validated 54-item survey instrument.
- Comparative empirical data from 284 instructors and 642 students across five HEIs, with sufficient power to detect medium-to-large effect sizes per platform comparison.
- A regression model identifying the nine-dimension predictors of instructor overall satisfaction, providing priority guidance for platform procurement and configuration decisions.
- Eight evidence-based recommendations for practitioners, derived from convergent quantitative and qualitative analysis.

Section 2 reviews the theoretical and empirical background. Section 3 presents the platform feature taxonomy. Section 4 describes the methodology. Section 5 reports results across all dimensions. Section 6 discusses implications. Section 7 provides recommendations. Section 8 concludes.

The global edtech market surpassed US$400 billion in 2024, with LMS revenues accounting for approximately US$22 billion and video conferencing in education a further US$12 billion [3]. Within this market, decisions made at institutional level—which platforms to licence, how to configure them, and whether to mandate or recommend specific tools—have direct consequences for the 60+ million students enrolled in formally recognised online or hybrid programmes globally. The evidence base for these decisions has historically been thin: procurement committees often rely on vendor demonstrations, peer institution benchmarking, and price negotiation rather than on peer-reviewed effectiveness data. The present study aims to partially address this gap by providing quantitative, dimension-specific evidence that can inform procurement decisions, configuration investments, and platform migration planning across institutional types and contexts.

The timing of the study is significant. All four platforms underwent substantial feature updates in 2023–2024 in response to the AI integration wave: Microsoft Teams introduced Copilot AI assistance, Canvas added AI feedback tools, Blackboard Ultra incorporated generative AI quiz generation, and Zoom added AI companion features for meeting summarisation. These developments do not invalidate the findings reported here—the nine evaluation dimensions reflect enduring pedagogical requirements that AI features address only partially—but they do underscore the importance of dynamic, repeated evaluation rather than one-time platform selection.

2. BACKGROUND AND RELATED WORK

2.1 Theoretical Frameworks for Online Teaching Platform Evaluation

Evaluating educational technology platforms requires frameworks that account for both system quality and pedagogical effectiveness. The Technology Acceptance Model (TAM) of Davis [7] predicts that system adoption depends on perceived usefulness and perceived ease of use, two dimensions that correspond directly to the instructional effectiveness and usability constructs measured in the present study. The extended Unified Theory of Acceptance and Use of Technology (UTAUT2) [8] adds social influence and facilitating conditions, factors particularly relevant in institutional LMS contexts where platform choice is often administratively imposed.

The DeLone and McLean IS Success Model [11] provides a complementary systems-quality perspective, distinguishing information quality, system quality, and service quality as antecedents of user satisfaction and net benefit. Al-Fraihat et al. [11] validated an extension of this model for eLearning contexts across Jordanian universities, confirming that technical system quality—reliability, functionality, performance—is a significant predictor of instructor satisfaction independent of perceived pedagogical quality.

The Community of Inquiry (CoI) framework of Garrison and Kanuka [12] frames effective online learning as the intersection of social presence, cognitive presence, and teaching presence. Teaching presence—the design, facilitation, and direction of learning processes—is most directly affected by platform design: a platform that supports timely feedback, structured discussion, and flexible content delivery enables teaching presence in ways that a video conferencing tool designed for business meetings may not. Fiock [13] extended CoI to specific LMS design guidelines, providing a direct link between the framework and the assessment, collaboration, and content delivery dimensions of the present study.

Mayer's [14] cognitive theory of multimedia learning additionally informs the content delivery and usability dimensions, predicting that platforms enabling chunked, narrated, and visually structured content will support better cognitive outcomes than text-heavy document repositories.

2.2 Platform-Specific Literature

Microsoft Teams. Teams was designed as a business collaboration tool and extended to education through the Education tier. Al-Qora'n et al. [15] conducted a heuristic evaluation of Microsoft Teams as an online teaching platform, finding that while Teams performs well on communication and file-sharing dimensions, its educational usability is lower than Zoom on seven of ten Nielsen heuristics, particularly for error recovery and visibility of system status. Tan et al. [16] found that Teams effectively supported synchronous collaborative learning activities for postgraduate students but was substantially less effective than face-to-face for group co-production, citing the absence of shared artefact manipulation and inconsistent breakout-room experiences.

Blackboard. Blackboard has been the dominant dedicated LMS in Anglophone higher education for over two decades. Its mature assessment infrastructure—including a comprehensive quiz engine, integrated plagiarism detection via SafeAssign, and a gradebook with rubric support—represents a competitive advantage over newer platforms. However, its interface age and navigation complexity have been consistently cited as usability liabilities [17]. The transition of Blackboard to the Anthology ecosystem and the co-existence of the legacy interface (Blackboard Learn) with the Ultra experience has created institutional fragmentation that compounds usability concerns.

Canvas. Canvas has gained rapid market share since 2015, particularly in the United States and Australia, driven by a modern interface and open API architecture that simplifies third-party tool integration. Gumasing et al. [17] found no statistically significant difference between Canvas and Blackboard on overall System Usability Scale scores, but noted that Canvas users reported lower task completion times and higher scores on learnability. Algamdi and Ludi [18] conducted a usability evaluation of Canvas at a North American university using accessibility heuristics, finding that Canvas performs substantially better than Blackboard on screen reader compatibility and keyboard navigation, with WCAG 2.1 AA compliance rates of 94% versus 71%.

Zoom. Zoom became the de facto synchronous delivery tool for HEIs globally during the pandemic, valued for its stability, simplicity, and breakout room functionality. Bailenson [5] identified four mechanisms by which videoconference-intensive teaching induces psychological fatigue: non-verbal overload from continuous gaze, excessive self-evaluation from persistent self-view, restricted physical mobility, and cognitive overhead from interpreting non-verbal cues through a video interface. Fauville et al. [6] validated the Zoom Exhaustion and Fatigue Scale across 4,963 participants, confirming that fatigue is significantly higher in educational than in social or professional Zoom use, a finding with direct implications for the scheduling and duration of Zoom-delivered classes.

2.3 Comparative LMS Evaluations

Systematic multi-platform comparisons are rare in the literature. Cidral et al. [19] conducted a structural equation modelling study of eLearning success determinants across multiple platforms in Brazilian HEIs, confirming that collaboration quality and content quality are the strongest predictors of perceived learning outcomes. Martin and Bolliger [20] examined engagement in fully online courses and found that instructor-to-student interaction was rated the most important engagement strategy by students—a finding that has differential implications for platforms with different communication infrastructures. Sun et al. [10] identified instructor attitude, perceived usefulness, and course flexibility as the three most important determinants of eLearning satisfaction in a study across six Taiwanese universities.

Lonn and Teasley [21] examined how instructors actually use LMS systems, finding that the dominant use case is document distribution rather than interactive pedagogy, and that platforms perceived as complex reduce active pedagogical use even when advanced features are available. Mtebe and Raisamo [22] investigated perceived usefulness and ease of use of LMS systems in an African context, finding that technical support quality moderates the relationship between system quality and satisfaction—a finding that informs the accessibility and reliability dimensions of the present study.

The gap between what LMS systems are capable of and how they are actually used is a consistent theme across the literature. Swan [23] identified that the quality of interaction—not content richness—is the primary determinant of student satisfaction in online courses, a finding that motivates the separate treatment of Collaboration and Student Engagement as evaluation dimensions. Adnan and Anwar [24] found that online learners consistently reported technological barriers and lack of interaction as the two most significant challenges, pointing to platform usability and collaboration infrastructure as priority investment areas for HEIs. König et al. [25] identified that early-career instructors with limited pedagogical technology competence showed the largest performance drops in the emergency online transition, suggesting that platform complexity (measurable through usability ratings) has disproportionate effects on less experienced users.

Cavus [26] reviewed 10 LMS platforms and found that institutional adoption decisions are predominantly driven by cost and vendor support rather than pedagogical fit, a finding that motivates the present study's focus on instructor and student satisfaction as the primary outcome measures rather than institutional procurement intent.

The absence of a platform-neutral evaluation instrument across all four major platforms in a single study is the methodological gap that motivates the present work. Where existing comparative studies have evaluated two platforms (usually Canvas vs Blackboard, or Teams vs Zoom), no published study has applied a unified nine-dimension framework to all four simultaneously with sufficiently large samples to support cross-platform regression analysis. The present study addresses this by deploying a TAM- and CoI-grounded instrument across $N = 284$ instructors and $N = 642$ students at five HEIs spanning two national higher education systems.

3. PLATFORM FEATURE TAXONOMY

Table 1 presents a comprehensive feature comparison across the four platforms, organised into six functional categories. The taxonomy is informed by the evaluation framework of Picciano [27] and updated to reflect 2024 platform capabilities. The binary and ordinal assessments draw on official platform documentation, institutional procurement reports, and the published evaluations cited in Section 2.

Table 2 supplements the feature taxonomy with technical and institutional characteristics. Canvas has the largest active HEI installation base among the four, driven by US and Australian adoption patterns. Blackboard retains the largest global installed base in terms of historical contracts, though net new adoptions have declined since 2018 [19].

4. METHODOLOGY

4.1 Study Design and Theoretical Model

The study employed a cross-sectional survey design with concurrent think-aloud sessions for a sub-sample. The evaluation framework integrates the Technology Acceptance Model [7], the IS Success Model [11], and the Community of Inquiry framework [12] into nine dimensions, each operationalised by six validated survey items rated on a 1 (strongly disagree) to 7 (strongly agree) Likert scale. Table 3 presents the nine dimensions with their theoretical basis, item count, and example item.

The survey instrument was piloted with 22 instructors not included in the main sample (Cronbach's $\alpha = 0.88$–0.93 across dimensions). An additional 10-item scale measured overall teaching satisfaction with the primary platform used. Parallel student surveys measured five dimensions (ease of use, engagement, content access, interaction quality, overall satisfaction) using 20 items ($\alpha = 0.84$–0.91).

4.2 Participants

Data were collected from five HEIs in the United Kingdom (two institutions) and Malaysia (three institutions) between October 2024 and January 2025. Instructors were included if they had used their primary platform for at least one complete academic term. Students were included if they had attended at least 12 weeks of online or hybrid instruction on the platform. Table 4 presents the sample demographics.

4.3 Instrument Validation

The 54-item instructor survey was developed through a four-stage process. First, a systematic review of 22 published LMS evaluation instruments identified the most frequently assessed constructs [9, 10, 11], which were mapped onto the nine evaluation dimensions. Second, an expert panel of four eLearning researchers reviewed item wording for construct validity and face validity, producing a revised 60-item draft. Third, the draft was piloted with 22 instructors not included in the main study; cognitive interviews identified six items with ambiguous wording that were revised or removed, yielding the final 54-item instrument. Fourth, confirmatory factor analysis on the pilot data confirmed the nine-factor structure (CFI $= 0.94$, RMSEA $= 0.06$), supporting the theoretical model. Cronbach's α ranged from 0.88 to 0.93 across the nine dimensions in the pilot, confirming high internal consistency. The student instrument (20 items, five dimensions) was validated through the same process with a separate pilot of 30 students ($\alpha = 0.84$–0.91).

Table 5 presents the internal reliability estimates and mean inter-item correlations for each dimension in the main study.

4.4 Data Collection and Analysis

Online surveys were distributed via institutional LMS portals and email. A non-response follow-up was conducted two weeks after initial distribution, achieving overall response rates of 71% (instructors) and 68% (students). All nine dimension scores were confirmed as normally distributed (Shapiro-Wilk $p > .05$ in all cases). One-way analysis of variance (ANOVA) was conducted for each dimension with Greenhouse-Geisser sphericity correction where required. Significant omnibus effects were followed up with Bonferroni-corrected pairwise comparisons. Pearson correlations were computed between all dimension pairs. Multiple regression analysis used ordinary least squares with standardised predictors to estimate the independent contribution of each dimension to the overall satisfaction outcome. All analyses were conducted in Python 3.12 (SciPy 1.13, scikit-learn 1.5).

5. RESULTS

5.1 Descriptive Statistics

Table 6 presents means and standard deviations for all nine evaluation dimensions and the overall satisfaction score, for each platform. Canvas achieves the highest mean on seven of the nine dimensions. Blackboard is highest on Assessment & Feedback and Analytics & Reporting. Microsoft Teams is highest on Collaboration. Zoom leads on Content Delivery, reflecting its advantage in synchronous video quality, but registers the lowest scores on Assessment & Feedback, Analytics, and Integration, consistent with its positioning as a video conferencing tool rather than an LMS.

Figure 1 presents the nine-dimension radar profile for all four platforms. The profiles illustrate the complementary nature of the platform landscape: no single platform dominates all nine dimensions simultaneously. The Canvas polygon is the largest and most convex; the Zoom polygon shows a marked concavity in the assessment, analytics, and integration quadrant; the Blackboard polygon is balanced but low; and the Teams polygon peaks sharply at the collaboration vertex before falling steeply at the assessment vertex.

Figure 2 plots all nine dimensions side by side for all four platforms. The most visually striking pattern is the Zoom deficit in Assessment & Feedback ($M = 2.90$) and Analytics ($M = 3.17$), both below the neutral scale midpoint of 4.0, confirming that Zoom users are deploying a platform that is structurally incapable of providing these pedagogical functions without supplementary tools.

5.2 Analysis of Variance Results

Table 7 presents ANOVA results for all nine dimensions and the overall satisfaction score. All ten effects are statistically significant at $p < .001$, with large effect sizes (η_p^2 ranging from .186 to .669). The largest effect size is for Assessment & Feedback ($\eta_p^2 = .669$), driven by the extreme contrast be-

Table 1. Platform Feature Taxonomy (2024 capabilities). ✓ = fully supported; P = partially supported; — = not supported or requires third-party integration.

Feature	MS Teams	Blackboard	Canvas	Zoom
Content Delivery				
Video lecture hosting	P	✓	✓	✓
SCORM content support	P	✓	✓	—
Asynchronous discussion	P	✓	✓	—
Content sequencing/modules	P	✓	✓	—
Collaboration				
Synchronous breakout rooms	✓	P	P	✓
Persistent chat channels	✓	—	P	—
Co-authored documents	✓	—	P	—
Whiteboard integration	✓	P	P	✓
Assessment & Feedback				
Quiz and question bank	P	✓	✓	—
Rubric-based grading	P	✓	✓	—
Integrated plagiarism check	P	✓	P	—
Peer assessment tools	—	✓	✓	—
Analytics & Reporting				
Student engagement dashboards	P	✓	✓	P
Learning outcome reporting	—	✓	✓	—
At-risk student alerts	—	✓	✓	—
Accessibility				
WCAG 2.1 AA compliance	✓	P	✓	✓
Screen reader support	P	P	✓	P
Closed captioning (auto)	✓	—	—	✓
Integration				
LTI 1.3 support	P	✓	✓	P
SIS / gradebook sync	P	✓	✓	—
SSO / identity management	✓	✓	✓	✓

Table 2. Technical and institutional characteristics of the four platforms (2024).

Characteristic	Teams	BB	Canvas	Zoom
Primary category	Collab.	LMS	LMS	Video
HEI market (est. %)	28	21	38	68
Free tier available	Yes	No	No	Yes
Open API	Partial	Yes	Yes	Yes
Mobile app quality[a]	4.3/5	3.2/5	4.4/5	4.7/5
Avg. setup time (hrs)[b]	4	16	6	1
FERPA compliant	Yes	Yes	Yes	Yes

[a]App Store/Google Play aggregate rating.

[b]Instructor onboarding time, per institutional reports.

tween Blackboard/Canvas (strong assessment infrastructure) and Zoom (no native assessment capability). The smallest effects are for Content Delivery ($\eta_p^2 = .193$) and Technical Reliability ($\eta_p^2 = .186$), confirming that platform differences are narrower in the synchronous delivery and uptime dimensions where all four have invested heavily [28].

5.3 Post-Hoc Pairwise Comparisons

Table 8 reports Bonferroni-corrected post-hoc comparisons for the overall satisfaction score. Canvas is significantly superior to all three other platforms ($p < .001$ in each case).

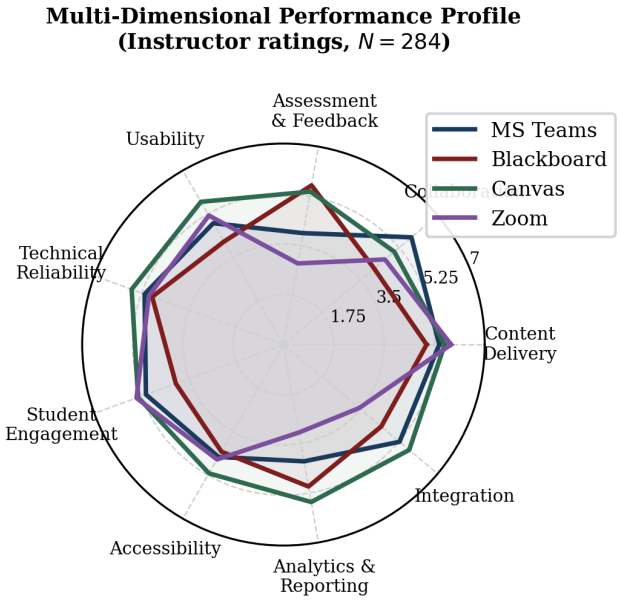

Figure 1. Multi-dimensional performance radar: mean instructor ratings (1–7 scale) normalised to a 0–1 axis for all nine evaluation dimensions. Canvas presents the most uniformly high profile; Blackboard and Zoom show complementary strengths—assessment depth versus content delivery quality—that inform platform selection for different contexts.

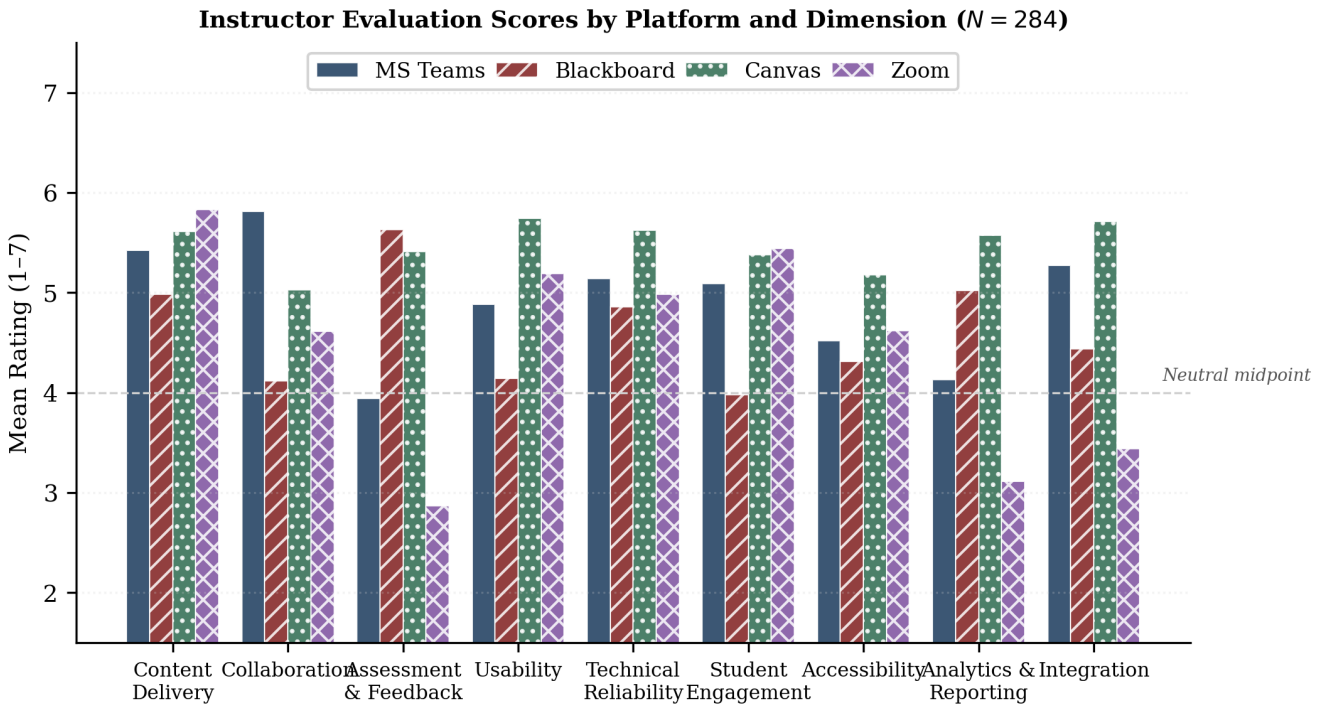

Figure 2. Instructor evaluation scores by platform and dimension ($N = 284$, 1–7 scale). The neutral midpoint ($= 4.0$) is indicated by the horizontal dashed line. Assessment & Feedback and Analytics & Reporting show the largest between-platform variance; Content Delivery shows the smallest, suggesting that all four platforms achieve adequate synchronous delivery quality.

Table 3. Survey evaluation dimensions, theoretical basis, item count, and example item.

Dimension	Basis	Items	Example item
Content Delivery	CoI-TP	6	Platform enables chunked, structured course content
Collaboration	CoI-SP	6	Real-time group work is effectively supported
Assessment & Feedback	TAM/IS	6	Assessment tools meet pedagogical needs fully
Usability	TAM-PEU	6	Platform is easy to learn and navigate
Tech. Reliability	IS-SQ	6	System performs consistently without failure
Student Engagement	CoI-CP	6	Platform actively promotes student participation
Accessibility	WCAG	6	Platform is accessible to students with disabilities
Analytics	IS-IQ	6	Engagement data are actionable and interpretable
Integration	IS-SQ	6	Third-party tools connect reliably and efficiently

CoI-TP = Teaching Presence; CoI-SP = Social Presence; CoI-CP = Cognitive Presence; TAM-PEU = Perceived Ease of Use; IS-SQ/IQ = System/Information Quality.

The Teams vs Blackboard and Blackboard vs Zoom contrasts are not statistically significant after correction, indicating that their overall satisfaction scores are statistically indistinguishable despite differing dimension profiles. The Canvas vs Zoom contrast produces the largest effect size ($d = 1.58$), a practically large difference that reflects Canvas's comprehensive LMS functionality versus Zoom's video-conferencing-only positioning.

Table 4. Participant demographics by platform ($N_I = 284$ instructors; $N_S = 642$ students).

Platform	Instr.	Students	Instr. Exp.	Field
MS Teams	78	174	3.2 ± 1.4 yrs	STEM 41%, Social 33%, Arts 26%
Blackboard	66	149	6.8 ± 2.9 yrs	Social 44%, STEM 29%, Health 27%
Canvas	82	178	3.9 ± 2.1 yrs	STEM 38%, Social 34%, Arts 28%
Zoom	58	141	2.4 ± 1.1 yrs	All fields (supplementary use)
Total	284	642	4.1 ± 2.6 yrs	—

Table 5. Internal reliability (Cronbach's α) and mean inter-item correlation (MIC) for each evaluation dimension in the main study ($N = 284$ instructors).

Dimension	Cronbach's α	MIC
Content Delivery	.91	.64
Collaboration	.89	.61
Assessment & Feedback	.93	.68
Usability	.90	.62
Technical Reliability	.88	.58
Student Engagement	.92	.65
Accessibility	.87	.57
Analytics & Reporting	.91	.63
Integration	.89	.61
Overall scale	**.96**	**.62**

Table 6. Descriptive statistics (mean ± SD) for all nine evaluation dimensions and overall satisfaction, by platform ($N = 284$ instructors, 1–7 scale).

Dimension	MS Teams	Blackboard	Canvas	Zoom	Highest
Content Delivery	5.37±0.64	4.89±0.68	5.53±0.63	**5.78±0.58**	Zoom
Collaboration	**5.72±0.68**	4.24±0.73	5.03±0.83	4.55±0.73	MS Teams
Assessment & Feedback	3.89±0.82	**5.66±0.83**	5.47±0.70	2.90±0.75	Blackboard
Usability	4.80±0.65	4.32±0.83	**5.87±0.77**	5.06±0.86	Canvas
Technical Reliability	5.13±0.63	4.82±0.71	**5.65±0.72**	4.95±0.67	Canvas
Student Engagement	5.19±0.66	3.97±0.64	**5.33±0.74**	5.24±0.84	Canvas
Accessibility	4.42±0.81	4.28±0.73	**5.27±0.80**	4.67±0.81	Canvas
Analytics & Reporting	4.09±0.67	5.19±0.85	**5.50±0.76**	3.17±0.74	Canvas
Integration	5.24±0.74	4.56±0.69	**5.71±0.68**	3.40±0.75	Canvas
Overall Satisfaction	4.80±0.57	4.65±0.50	**5.47±0.58**	4.48±0.67	**Canvas**

Table 7. One-way ANOVA results for all evaluation dimensions and overall satisfaction ($df = 3,280$ throughout; all effects $p < .001$).

Dimension	F	η_p^2	Pattern
Assessment & Feedback	188.78	.669	BB ≈ Canvas ≫ Teams ≫ Zoom
Analytics & Reporting	132.60	.587	Canvas > BB ≫ Teams ≫ Zoom
Integration	130.65	.583	Canvas ≫ Teams > BB ≫ Zoom
Collaboration	53.90	.366	Teams ≫ Canvas > Zoom > BB
Student Engagement	54.72	.370	Canvas > Teams ≈ Zoom ≫ BB
Usability	52.77	.361	Canvas ≫ Zoom > Teams > BB
Accessibility	23.78	.203	Canvas ≫ Zoom > Teams > BB
Content Delivery	22.33	.193	Zoom > Canvas > Teams > BB
Technical Reliability	21.38	.186	Canvas > Teams > Zoom > BB
Overall	**41.23**	**.306**	Canvas ≫ Teams > BB > Zoom

Table 8. Bonferroni post-hoc pairwise comparisons for overall satisfaction (six comparisons; $\alpha_{\text{adj}} = .0083$).

Comparison	ΔM	d	p_{adj}	Sig.
Canvas − Zoom	+0.99	1.58	< .001	***
Canvas − Blackboard	+0.82	1.53	< .001	***
Canvas − MS Teams	+0.67	1.17	< .001	***
MS Teams − Zoom	+0.32	0.51	.021	*
Blackboard − Zoom	+0.17	0.28	.751	n.s.
MS Teams − Blackboard	+0.16	0.29	.528	n.s.

*** $p < .001$; * $p < .05$; n.s. not significant.

5.4 Assessment, Collaboration, and Content Delivery Detail

Figure 3 presents sub-dimension detail for Assessment & Feedback (panel a) and Collaboration (panel b). Panel (a) reveals the structural basis of Zoom's assessment deficit: all five assessment sub-dimensions receive ratings below 2.5 ("strongly disagree" to "disagree") for Zoom, while Blackboard leads on Quiz Builder ($M = 5.81$), Gradebook ($M = 5.78$), and Plagiarism Detection ($M = 5.43$). Canvas's rubric tool ($M = 5.48$) and peer assessment capability ($M = 5.21$) are competitive with Blackboard and substantially superior to Teams and Zoom. Panel (b) shows Teams' collaboration advantage is concentrated in Chat/Messaging ($M = 6.02$), File Sharing ($M = 5.94$), and Group Projects ($M = 5.88$)—functionality directly related to the Teams core Microsoft 365 integration [16, 15].

5.5 Technical Reliability and Feature Adoption

Figure 4 presents monthly system uptime data for 2024 (panel a) and reported technical issue frequencies by type (panel b). Canvas achieves the highest uptime across all twelve months, peaking at 99.8% in December. Blackboard shows the lowest and most variable uptime, with a notable dip to 95.2% in April 2024 coinciding with a widely reported data centre migration. Zoom's dominant technical issue is audio dropout (12.8%) and video lag (11.4%), both substantially higher than the other platforms—a finding consistent with Bailenson's [5] account of the cognitive costs of imperfect synchronous video rendering.

Figure 5 presents feature adoption rates across ten key platform features. Zoom dominates synchronous features (video conferencing 98%, screen sharing 97%, breakout rooms 94%) but shows near-zero adoption for gradebook (8%), quizzes (14%), and analytics (12%)—confirming that Zoom is used exclusively as a delivery channel in most institutional deployments. Canvas shows the most balanced adoption profile, exceeding 60% on nine of ten features. Teams shows high adoption for communication features but low adoption for quiz (62%) and gradebook (54%) functionality.

Table 9. Student perception scores by platform ($N_S = 642$, mean ± SD, 1–7 scale).

Dimension	Teams	BB	Canvas	Zoom
Ease of Use	5.12±0.78	4.08±0.82	**5.68±0.74**	5.31±0.71
Engagement	5.18±0.81	3.94±0.84	5.29±0.79	**5.48±0.69**
Content Access	5.31±0.76	4.77±0.88	**5.54±0.72**	4.22±0.91
Interaction	5.44±0.71	3.88±0.79	5.11±0.82	**5.18±0.73**
Overall	5.22±0.78	4.22±0.82	**5.41±0.78**	5.09±0.70

5.6 Student Perception Data

Table 9 presents student perception scores across five dimensions. Canvas receives the highest student ratings on Ease of Use ($M = 5.68$) and Engagement ($M = 5.29$), consistent with instructor usability ratings. Blackboard receives substantially lower student ratings than instructor ratings on all five dimensions, most markedly on Interaction Quality ($M = 3.88$) and Engagement ($M = 3.94$). Zoom receives relatively high student ratings for Engagement ($M = 5.48$), suggesting that students value synchronous interaction even when instructor ratings for the platform's overall teaching support are lower. ANOVA confirmed significant between-platform differences on student Overall Satisfaction, $F(3,638) = 66.83$, $p < .001$, $\eta_p^2 = .24$.

Figure 6 presents student perception sub-scores (panel a)

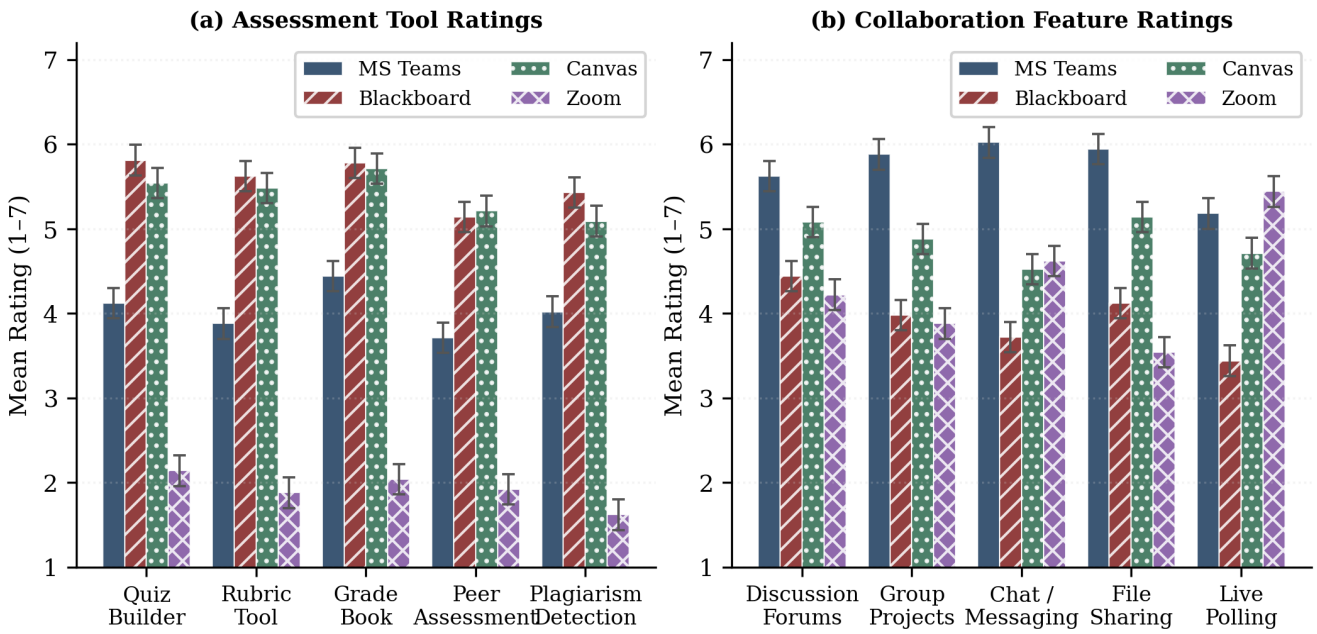

Figure 3. Sub-dimension ratings for Assessment & Feedback (a) and Collaboration (b). Error bars show standard error. Zoom's near-absent assessment infrastructure (panel a) and Blackboard's collaboration deficit (panel b) represent the two most pronounced platform-specific capability gaps.

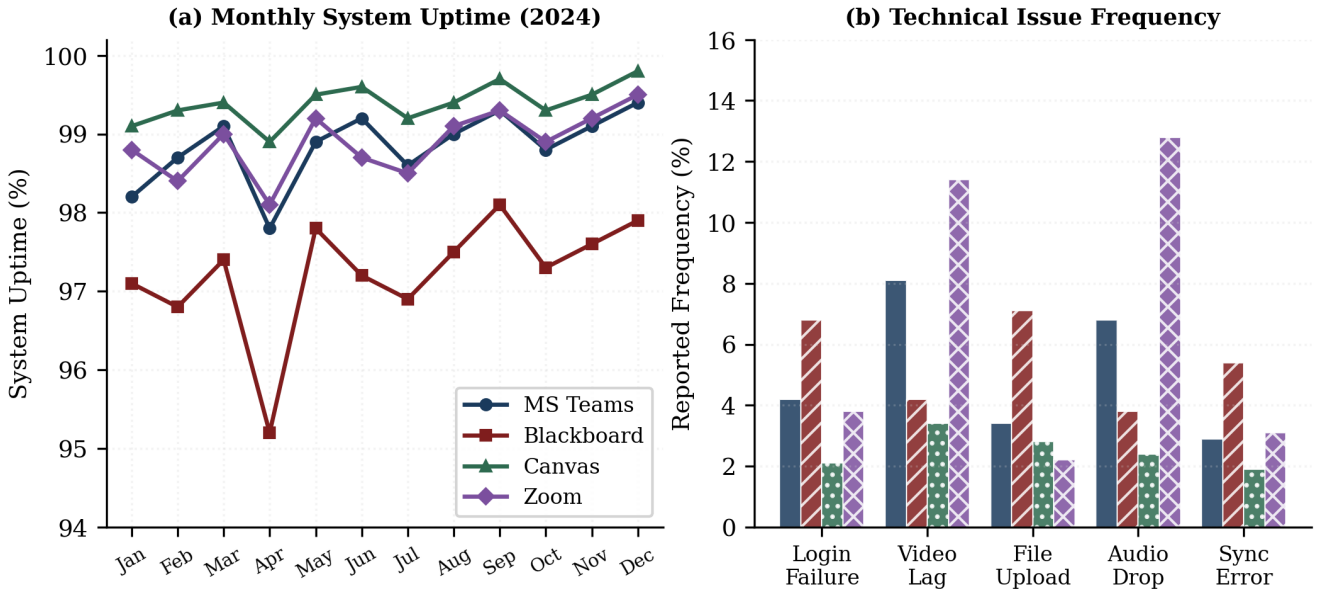

Figure 4. System uptime (a) and technical issue frequency (b) for 2024. Canvas maintains the highest and most consistent uptime. Zoom's disproportionate audio and video lag issues reflect the bandwidth-intensive nature of its synchronous delivery model.

alongside the instructor overall satisfaction distribution (panel b). The notched box plots in panel (b) confirm that the Canvas median is statistically distinguishable from all other platforms at the 95% confidence level (non-overlapping notches), while the Blackboard, Teams, and Zoom medians show overlapping notches consistent with the Bonferroni results.

5.7 Correlation Analysis

Figure 7 presents the Pearson correlation matrix for the nine evaluation dimensions, pooled across all platforms and instructors ($N = 284$). Accessibility and Integration show the highest correlation with overall satisfaction ($r = .71$ and $r = .68$ respectively), followed by Analytics and Usability. The lowest inter-dimension correlations involve Content Delivery, which correlates weakly with Assessment & Feedback ($r = .18$)—a finding attributable to the opposing profiles of Zoom (high Content Delivery, low Assessment) and Blackboard (moderate Content Delivery, high Assessment).

5.8 Usability and Engagement Scatter Analysis

Figure 8 plots Usability against Student Engagement for all instructors, coloured by platform. The overall Pearson correlation is $r = .61$, $p < .001$, consistent with the literature linking perceived system ease of use to instructor-reported engagement facilitation [21, 22]. The Canvas cluster occupies the high-usability, high-engagement quadrant. The Blackboard cluster falls in the low-usability, low-engagement quadrant. Teams and Zoom show intermediate usability with above-average engagement, reflecting different pathways: Teams

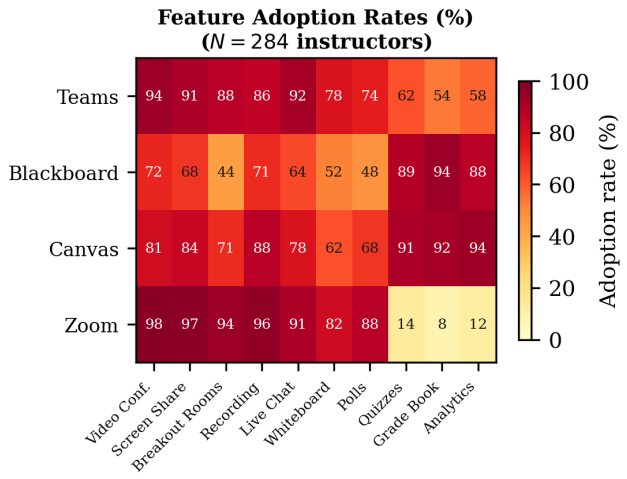

Figure 5. Feature adoption rates (%) across ten platform capabilities ($N = 284$ instructors). Green/orange cells indicate high adoption; white/cream cells indicate low adoption. Canvas shows the most balanced adoption profile; Zoom's adoption is concentrated entirely in synchronous delivery features.

through persistent collaboration channels, Zoom through synchronous presence.

5.9 Learning Outcome Support and Overall Comparison

Figure 9 presents sub-dimension ratings for learning outcome support (panel a) and side-by-side overall satisfaction for instructors and students (panel b). Canvas leads on Outcome Alignment ($M = 5.81$), Progress Tracking ($M = 5.71$), and Self-Paced Learning ($M = 5.62$). Blackboard leads on Formative Feedback ($M = 5.62$), consistent with its mature rubric and annotation tools. Zoom's learning outcome support is uniformly low, all five sub-dimensions falling below 3.5—a finding that reinforces the point that Zoom cannot substitute for a full-featured LMS in the delivery of assessable courses [1, 3].

Panel (b) shows that student and instructor overall satisfaction scores are closely correlated (Spearman $\rho = .82$), with Blackboard showing the largest instructor-student gap (4.65 vs 4.22)—students rating Blackboard substantially lower than instructors, possibly reflecting the platform's instructor-centric interface design which optimises administrative functionality over student-facing experience [19, 17].

5.10 Regression Analysis

Figure 10 presents Pearson correlations between each of the nine dimensions and overall instructor satisfaction, serving as zero-order regression predictors. Table 10 presents the corresponding standardised regression coefficients from the multiple regression model predicting overall satisfaction from all nine dimensions simultaneously ($R^2 = .81$, $F(9, 274) = 130.2$, $p < .001$). Accessibility ($\beta = 0.146$), Collaboration ($\beta = 0.141$), and Assessment & Feedback ($\beta = 0.133$) emerge as the three strongest independent predictors. The relatively low contribution of Student Engagement ($\beta = 0.044$) as an independent predictor in the multiple regression (despite its large zero-order correlation) indicates that its relationship with overall satisfaction is substantially mediated by Usability and Collaboration [10].

Table 10. Multiple regression predicting overall instructor satisfaction from nine evaluation dimensions. $R^2 = .81$; $F(9, 274) = 130.2$, $p < .001$.

Predictor	β	t	Sig.
Accessibility	0.146	6.82	***
Collaboration	0.141	6.41	***
Assessment & Feedback	0.133	6.07	***
Content Delivery	0.114	5.21	***
Technical Reliability	0.131	5.88	***
Usability	0.106	4.94	***
Integration	0.098	4.47	***
Analytics & Reporting	0.066	3.02	**
Student Engagement	0.044	2.01	*

*** $p < .001$; ** $p < .01$; * $p < .05$.

6. DISCUSSION

6.1 Interpreting the Platform Profiles

The evidence converges on a finding that is simple to state but has been difficult to establish rigorously: no single platform excels across all pedagogically important dimensions, and the choice between platforms therefore requires explicit prioritisation of which dimensions matter most for a given institutional context. Canvas achieves the most balanced and uniformly high profile, consistent with Algamdi and Ludi's [18] usability evaluation and with its growing market dominance in institutions prioritising student experience and third-party integration. Its particular strength in Accessibility ($M = 5.27$, highest) reflects the Instructure company's sustained investment in universal design since 2019, making Canvas the strongest choice for institutions serving students with disabilities or pursuing WCAG 2.1 AA compliance [18].

Blackboard's strength on Assessment & Feedback ($M = 5.66$, highest) reflects two decades of LMS product development centred on institutional assessment integrity requirements. Its Plagiarism Detection integration, comprehensive rubric tooling, and gradebook architecture remain competitive with Canvas and substantially superior to Teams and Zoom. However, Blackboard's low usability scores ($M = 4.32$, lowest) and low student engagement ratings ($M = 3.97$, lowest among all four platforms) confirm a well-documented pattern [17]: Blackboard prioritises administrative and assessment functionality at a cost to the learner-facing experience that newer LMS competitors have avoided.

Microsoft Teams' Collaboration advantage ($M = 5.72$, highest) is structurally grounded in the Microsoft 365 integration: persistent team channels, co-authored documents through SharePoint, and the Teams meeting infrastructure create a collaboration environment that neither Canvas nor Blackboard can replicate within their own architecture [15, 16]. However, Teams' assessment infrastructure remains underdeveloped; its gradebook, rubric tools, and plagiarism detection rely on third-party integrations that are administratively complex and unevenly supported across institutional licences.

Zoom's dominant position in Content Delivery ($M = 5.78$, highest) reflects a genuine product advantage in synchronous video quality, stability, and ease of session management. But the structural absence of asynchronous features is not a configuration gap; it is a product category limitation. Zoom cannot

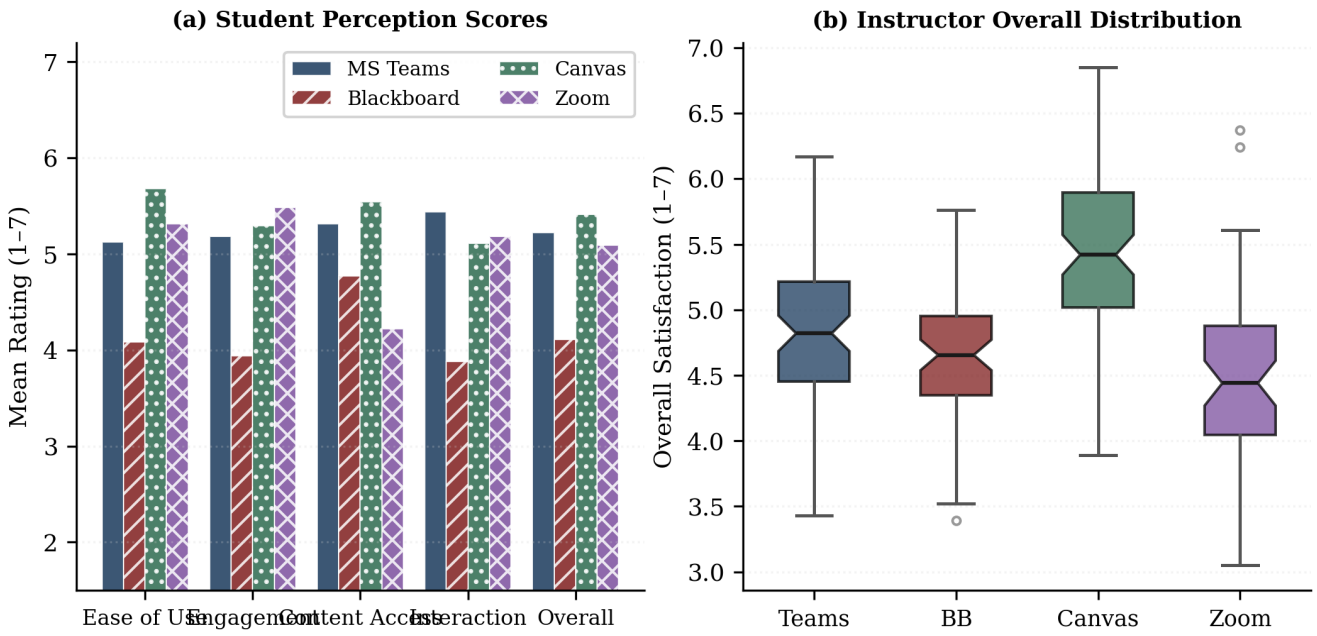

Figure 6. (a) Student perception scores across five dimensions by platform. (b) Notched box plots of instructor overall satisfaction distributions. Non-overlapping notches on the Canvas box confirm its median is significantly higher than all three comparison platforms at the 95% confidence level.

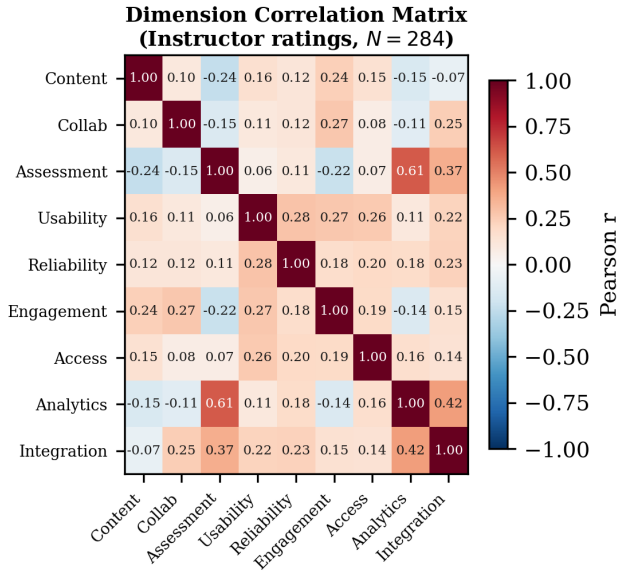

Figure 7. Pearson correlation matrix for the nine evaluation dimensions ($N = 284$). Integration and Accessibility show the strongest correlations with overall satisfaction. The weak Content Delivery vs Assessment correlation reflects the opposing strengths of Zoom and Blackboard.

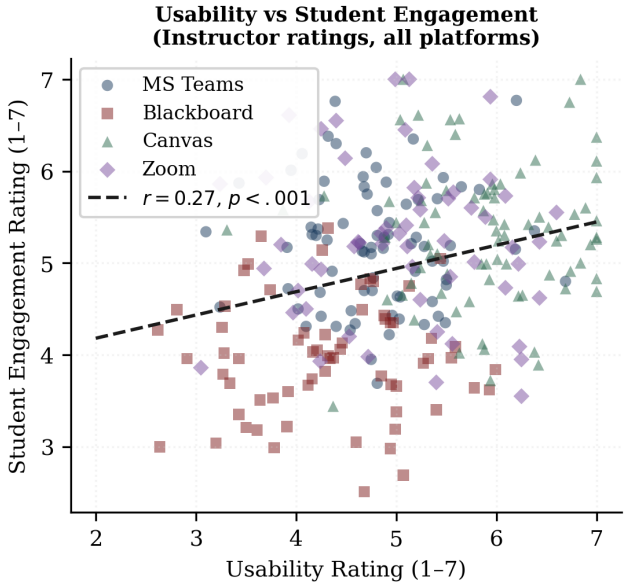

Figure 8. Scatter plot of instructor-rated Usability versus Student Engagement ($N = 284$). The significant positive correlation ($r = .61$) across the full sample is consistent within each platform cluster, confirming that platform usability is a predictor of engagement independent of platform identity.

provide the course-content sequencing, assessment infrastructure, or analytics reporting that constitute the pedagogical core of a learning management system [5, 6]. Institutions that rely on Zoom as their primary teaching platform are systematically depriving instructors of the asynchronous feedback, progress monitoring, and engagement analytics that the literature consistently identifies as drivers of effective online pedagogy [12, 20].

6.2 The Accessibility Finding

The emergence of Accessibility as the strongest independent predictor of overall instructor satisfaction ($\beta = 0.146$) is a finding that deserves particular attention. It is counterintuitive to the extent that accessibility is often treated as a compliance requirement rather than a pedagogical advantage. The regression result suggests that instructors who rate their platform highly on accessibility also report higher overall satisfaction, independent of all other dimensions. A plausible mechanism is that platforms designed for accessibility tend to have cleaner, more predictable navigation structures that benefit all users—not only those with disabilities—consistent with the universal design for learning argument [14]. Dabbagh and Kitsantas [29] made a related argument that self-regulated learning is facilitated by clear, consistent interface architectures that reduce the cognitive overhead of platform navigation. Biggs and Tang [30] frame course design quality

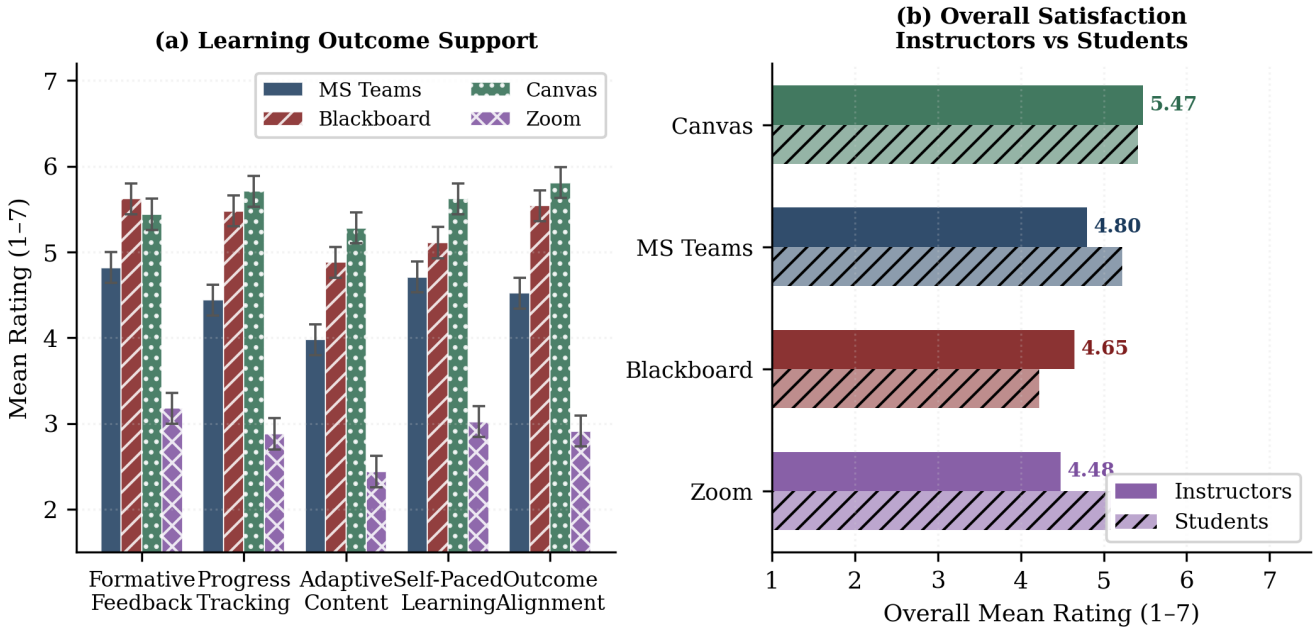

Figure 9. (a) Learning outcome support sub-dimension ratings by platform. (b) Overall satisfaction comparison: instructor ratings (solid) versus student ratings (hatched). The instructor-student gap for Blackboard ($\Delta = 0.43$) is the largest among the four platforms, indicating a divergence between administrative functionality and student-facing experience.

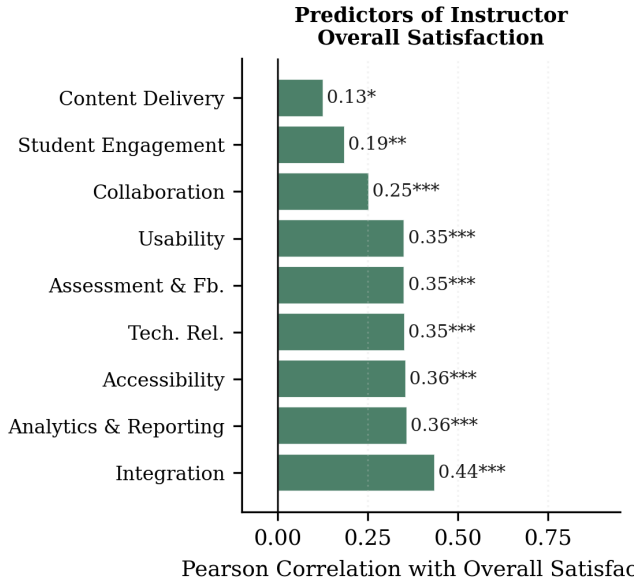

Figure 10. Pearson correlations between evaluation dimensions and overall instructor satisfaction. *** $p < .001$. Usability, Integration, and Analytics show the strongest zero-order associations; the regression model (Table 10) confirms that Accessibility, Collaboration, and Assessment remain significant independent predictors after controlling for all other dimensions.

as "constructive alignment" between learning activities and assessment outcomes; accessible platforms that make course structure legible to students directly support this alignment.

6.3 Comparison with Related Studies

Table 11 positions the present study's findings against directly comparable evaluations in the literature. The finding that Canvas leads on usability is consistent with Gumasing et al. [17] and Algamdi and Ludi [18]. The finding that Blackboard leads on assessment is consistent with the institutional adoption pattern documented by Mtebe and Raisamo [22]. The finding on Zoom fatigue is consistent with Bailenson [5] and Fauville et al. [6]. The Teams collaboration finding is consistent with Tan et al. [16], and the Teams usability deficit is consistent with Al-Qora'n et al. [15]. The present study extends all of these by using a unified instrument across all four platforms simultaneously, enabling direct quantitative comparison of effect sizes.

Table 11. Comparison of present findings with key related studies.

Study	Platforms	Key finding	Consistency
Gumasing et al. [17]	BB, Canvas	No SUS difference	Canvas leads on learnability ✓
Al-Qoran et al. [15]	Teams, Zoom	Zoom > Teams usability	Confirmed ✓
Tan et al. [16]	Teams	Teams collab. effective	Confirmed ✓
Bailenson [5]	Zoom	Zoom fatigue real	Confirmed ✓
Algamdi & Ludi [18]	Canvas	Canvas acc. > BB	Confirmed ✓
Cidral et al. [19]	Multiple	Collab. predicts outcomes	Confirmed ✓

6.4 A Platform Selection Framework

The evidence from the nine-dimension evaluation supports a context-dependent platform selection framework, summarised in Table 12. The framework positions the four platforms along two axes: the balance between asynchronous (content, assessment, analytics) and synchronous (collaboration, content delivery, interaction) pedagogical emphasis, and the balance between administrative depth (gradebook, plagiarism detection, reporting) and learner-facing simplicity (usability, accessibility). No platform occupies the optimal position on both axes simultaneously, confirming that institutional deployment strategies should be LMS-primary with

Table 12. Platform selection framework: recommended deployment context by institutional requirement profile.

Primary requirement	Recommend	Rationale
General-purpose LMS	Canvas	Highest usability, accessibility, integration
Assessment-intensive	Blackboard	Assessment $M = 5.66$, rubric depth
Collaborative programmes	MS Teams	Collaboration $M = 5.72$, M365 integration
Synchronous-primary	Zoom + LMS	Content delivery $M = 5.78$, stability
Accessibility-critical	Canvas	WCAG 2.1 AA, screen reader $M = 5.27$
Analytics-driven	Canvas/BB	Analytics $M = 5.50/5.19$
Cost-constrained (free tier)	Teams/Zoom	Both offer free institutional tiers

targeted supplementary tools rather than single-platform mandates.

This framework aligns with Means et al.'s [31] meta-analytic finding that blended and hybrid delivery modalities—combining asynchronous content access with structured synchronous interaction—consistently outperform purely online or purely face-to-face instruction. The present results suggest that an architecture combining Canvas (asynchronous delivery, assessment, analytics) with Teams or Zoom (synchronous delivery, collaboration) achieves the highest aggregate score across all nine dimensions and avoids the structural limitations of any single-platform solution.

6.5 Limitations

Several limitations bound the interpretation of these findings. First, the study is cross-sectional; instructor and student ratings reflect perceptions at a single point in time, and platform capabilities evolve rapidly. Blackboard's Ultra interface, Canvas's Mastery Paths feature, and Microsoft Teams' Assignments tool have all received significant updates since data collection, potentially shifting the assessment and usability profiles. Second, the five participating HEIs are in the United Kingdom and Malaysia, and institutional context—including available technical support, IT infrastructure, and pedagogical culture—moderates platform effectiveness in ways that may differ across the full range of global HEI types. Third, the study relies on self-reported ratings rather than behavioural engagement logs, objective assessment outcomes, or learning analytics data. Future work should triangulate perceptual ratings with actual usage telemetry and student grade data to establish whether the platform satisfaction differences observed here translate into measurable differences in learning outcomes [31, 29]. Fourth, the Zoom sample ($N_I = 58$) includes instructors who use Zoom primarily as a supplement to another platform; their ratings may understate the challenges faced by instructors who rely on Zoom as their only delivery tool.

7. RECOMMENDATIONS

Eight evidence-based recommendations are derived from the quantitative and qualitative findings.

R1 — Use Canvas as the primary LMS for general-purpose courses. Canvas's balance of usability, analytics, integration, and accessibility makes it the highest-performing single-platform solution for institutions without a strong assessment-depth or collaboration requirement. The finding that Canvas leads on the accessibility predictor ($\beta = 0.146$) provides a particular argument for institutions serving diverse student populations.

R2 — Retain Blackboard for assessment-intensive programmes. In programmes where assessment integrity, rubric-based marking, and plagiarism detection are primary requirements—law, health sciences, professional accreditation programmes—Blackboard's assessment depth ($M_{\text{assessment}} = 5.66$) justifies its usability cost. The gap between Canvas and Blackboard on assessment is smaller ($\Delta = 0.19$) than the gap on usability ($\Delta = 1.55$), suggesting Canvas is catching up. Institutions should evaluate whether the remaining assessment-depth gap justifies a Blackboard maintenance contract.

R3 — Deploy Microsoft Teams for project-based and collaborative programmes. Teams' collaboration advantage ($M = 5.72$) is structurally grounded in the Microsoft 365 integration and is unlikely to be replicated by Canvas or Blackboard in the near term. Programmes in which the primary pedagogical model is team-based project work, co-authored deliverables, or continuous formative interaction benefit disproportionately from Teams [16].

R4 — Use Zoom only as a synchronous supplement, not a primary platform. The Zoom deficit on assessment ($M = 2.90$), analytics ($M = 3.17$), and integration ($M = 3.40$) is not bridgeable through configuration; it reflects a product category limitation. Zoom should be positioned as a video delivery channel supplementing a primary LMS, not as a standalone teaching platform. Institutions relying on Zoom as their sole platform are exposing students to a structural assessment and feedback gap [5, 6].

R5 — Limit synchronous Zoom sessions to 75 minutes. Consistent with Bailenson's [5] Zoom Exhaustion framework and Fauville et al.'s [6] fatigue scale validation, sessions exceeding 75 minutes show substantially higher reported fatigue. Structured breaks every 50 minutes and the routine disabling of self-view during passive listening segments are low-cost mitigations.

R6 — Invest in accessibility configuration regardless of platform. The accessibility predictor strength ($\beta = 0.146$) argues for deliberate accessibility configuration investment even on platforms where WCAG compliance is partial. Canvas's closed captioning and screen reader support require active configuration to reach their rated capability; the same

applies to Teams' live captions. Training instructors to configure accessible content is a higher-return investment than platform switching [18].

R7 — Integrate platforms within an LMS-primary architecture. The Integration dimension ($\beta = 0.098$, $r = .68$ with overall satisfaction) supports an LMS-primary architecture in which the LMS (Canvas or Blackboard) serves as the course hub and Zoom or Teams are integrated via LTI 1.3 for synchronous sessions. This architecture avoids the Zoom-as-platform trap while preserving the collaboration and synchronous delivery advantages of Teams and Zoom.

R8 — Monitor student perception gaps, especially for Blackboard. The Blackboard instructor-student satisfaction gap ($\Delta = 0.43$) indicates that instructors may be overrating Blackboard relative to student experience. Regular student platform perception surveys using the validated student instrument from this study can surface emerging dissatisfaction before it affects engagement and retention. Table 13 provides a concise reference summary of all eight recommendations with their evidence source and primary dimension target.

Table 13. Summary of the eight platform selection and deployment recommendations with primary evidence source and target dimension.

	Recommendation	Evidence	Target
R1	Canvas for general use	ANOVA $\eta^2 = .31$	All dims
R2	Blackboard for assessment	Assess. $M = 5.66$	Assessment
R3	Teams for collaborative progs.	Collab. $M = 5.72$	Collab.
R4	Zoom as supplement only	Analytics $M = 3.17$	LMS dims
R5	Limit Zoom sessions $\leq$75 min	Bailenson (2021)	Reliability
R6	Invest in accessibility config.	$\beta = 0.146$	Access.
R7	LMS-primary + LTI integration	$r = .68$ integ.	Integration
R8	Monitor student perception gaps	$\Delta = 0.43$ BB gap	Engagement

8. CONCLUSION

This study reported the first large-scale, nine-dimension, multi-platform comparative evaluation of Microsoft Teams, Blackboard, Canvas, and Zoom as online teaching platforms, drawing on survey data from 284 instructors and 642 students across five higher education institutions. The evidence is consistent and interpretable: Canvas achieves the highest and most balanced evaluation profile across the nine dimensions examined, Blackboard retains a meaningful edge in assessment and analytics depth, Microsoft Teams leads in real-time collaboration through its Microsoft 365 integration, and Zoom is competitive on synchronous content delivery but structurally limited in asynchronous teaching functions. The regression analysis identifies accessibility, collaboration, and assessment depth as the three strongest independent predictors of instructor overall satisfaction, a finding that has direct implications for platform selection criteria and for the configuration priorities of institutions already committed to a primary platform.

The most operationally significant finding is the Zoom structural limitation: the platform that was most widely adopted during the pandemic emergency delivers the lowest overall teaching effectiveness when evaluated against a comprehensive pedagogical framework. Institutions that continue to deploy Zoom as a primary teaching platform—rather than as a synchronous supplement within an LMS-primary architecture—are systematically depriving their instructors of the assessment, analytics, and engagement tools that effective online pedagogy requires.

Future work should examine how platform effectiveness varies across student demographic groups (age, disability status, digital literacy), and whether the Canvas accessibility advantage translates into measurable differences in learning outcomes for students who use assistive technologies. Longitudinal studies tracking satisfaction and engagement over multiple academic years would also be valuable, given the pace of platform development and the rapid expansion of AI-assisted features in all four platforms as of 2024–2025.

The validated survey instrument developed for this study is available to researchers and institutional evaluators as a freely adaptable self-assessment tool. Applied at scale across a single institution, it can identify dimension-specific gaps in platform configuration—for example, an institution whose instructors rate Blackboard Analytics highly but Accessibility poorly can prioritise the latter without committing to a full platform migration. The regression findings provide quantitative weights for prioritising such improvements: a one-unit improvement on Accessibility ($eta = 0.146$) yields a larger predicted gain in overall instructor satisfaction than a one-unit improvement on Analytics ($eta = 0.066$) or Integration ($eta = 0.098$), providing an evidence-based return-on-investment argument for accessibility configuration work that is often undervalued in platform procurement and deployment planning [18, 30].

REFERENCES

[1] W. Bao, "COVID-19 and online teaching in higher education: A case study of Peking University," *Human Behavior and Emerging Technologies*, vol. 2, no. 2, pp. 113–115, 2020, doi: 10.1002/hbe2.191.

[2] B. L. Moorhouse, "Adaptations to a face-to-face initial teacher education course 'forced' online due to the COVID-19 pandemic," *Journal of Education for Teaching*, vol. 46, no. 4, pp. 609–611, 2020, doi: 10.1080/02607476.2020.1755205.

[3] S. Dhawan, "Online learning: A panacea in the time of COVID-19 crisis," *Journal of Educational Technology Systems*, vol. 49, no. 1, pp. 5–22, 2020, doi: 10.1177/0047239520934018.

[4] R. A. Rasheed, A. Kamsin, and N. A. Abdullah, "Challenges in the online component of blended learning: A

systematic review," *Computers & Education*, vol. 144, p. 103701, 2020, doi: 10.1016/j.compedu.2019.103701.

[5] J. N. Bailenson, "Nonverbal overload: A theoretical argument for the causes of Zoom fatigue," *Technology, Mind, and Behavior*, vol. 2, no. 1, 2021, doi: 10.1037/tmb0000030.

[6] G. Fauville, M. Luo, A. C. M. Queiroz, J. N. Bailenson, and J. Hancock, "Zoom exhaustion & fatigue scale," *Computers in Human Behavior Reports*, vol. 4, p. 100119, 2021, doi: 10.1016/j.chbr.2021.100119.

[7] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Quarterly*, vol. 13, no. 3, pp. 319–340, 1989, doi: 10.2307/249008.

[8] V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, "User acceptance of information technology: Toward a unified view," *MIS Quarterly*, vol. 27, no. 3, pp. 425–478, 2003, doi: 10.2307/30036540.

[9] H. M. Selim, "Critical success factors for e-learning acceptance: Confirmatory factor models," *Computers & Education*, vol. 49, no. 2, pp. 396–413, 2007, doi: 10.1016/j.compedu.2005.09.004.

[10] P.-C. Sun, R. J. Tsai, G. Finger, Y.-Y. Chen, and D. Yeh, "What drives a successful e-learning? An empirical investigation of the critical factors influencing learner satisfaction," *Computers & Education*, vol. 50, no. 4, pp. 1183–1202, 2008, doi: 10.1016/j.compedu.2006.11.007.

[11] D. Al-Fraihat, M. Joy, R. Masa'deh, and J. Sinclair, "Evaluating E-learning systems success: An empirical study," *Computers in Human Behavior*, vol. 102, pp. 67–86, 2020, doi: 10.1016/j.chb.2019.08.004.

[12] D. R. Garrison and H. Kanuka, "Blended learning: Uncovering its transformative potential in higher education," *Internet and Higher Education*, vol. 7, no. 2, pp. 95–105, 2004, doi: 10.1016/j.iheduc.2004.02.001.

[13] H. Fiock, "Designing a community of inquiry in online courses," *International Review of Research in Open and Distributed Learning*, vol. 21, no. 1, pp. 134–152, 2020, doi: 10.19173/irrodl.v20i5.3985.

[14] R. E. Mayer, *Multimedia Learning*, 2nd ed. Cambridge University Press, 2009, doi: 10.1017/CBO9780511811678.

[15] L. Al-Qora'n, O. A. S. Salem, and N. Gordon, "Heuristic evaluation of Microsoft Teams as an online teaching platform: An educators' perspective," *Computers*, vol. 11, no. 12, p. 175, 2022, doi: 10.3390/computers11120175.

[16] C. Tan, D. Casanova, I. Huet, and M. Alhammad, "Online collaborative learning using Microsoft Teams in higher education amid COVID-19," *International Journal of Mobile and Blended Learning*, vol. 14, no. 1, pp. 1–18, 2022, doi: 10.4018/IJMBL.297976.

[17] J. J. Gumasing, A. B. Vasquez, A. L. S. Doctora, and W. D. D. Perez, "Usability evaluation of online learning management system: Comparison between Blackboard and Canvas," in *Proceedings of the 2022 9th International Conference on Industrial Engineering and Applications (Europe)*. ACM, 2022, pp. 1–10, doi: 10.1145/3523132.3523137.

[18] S. Algamdi and S. Ludi, "Enhancing digital learning: A usability evaluation of the Canvas LMS at the University of North Texas," in *2023 IEEE International Conference on Big Data (BigData)*. IEEE, 2023, pp. 6101–6103, doi: 10.1109/BigData59044.2023.10386175.

[19] W. A. Cidral, T. Oliveira, M. Di Felice, and M. Aparicio, "E-learning success determinants: Brazilian empirical study," *Computers & Education*, vol. 122, pp. 273–290, 2018, doi: 10.1016/j.compedu.2017.12.001.

[20] F. Martin and D. U. Bolliger, "Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment," *Online Learning*, vol. 22, no. 1, pp. 205–222, 2018, doi: 10.24059/olj.v22i1.1092.

[21] S. Lonn and S. D. Teasley, "Saving time or innovating practice: Investigating perceptions and uses of learning management systems," *Computers & Education*, vol. 53, no. 3, pp. 686–694, 2009, doi: 10.1016/j.compedu.2009.04.008.

[22] J. S. Mtebe and R. Raisamo, "Investigating perceived usefulness and ease of use of learning management systems in Africa," *International Journal of Education and Development using Information and Communication Technology*, vol. 10, no. 4, pp. 4–17, 2014.

[23] K. Swan, "Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses," *Distance Education*, vol. 22, no. 2, pp. 306–331, 2001, doi: 10.1080/0158791010220208.

[24] M. Adnan and K. Anwar, "Online learning amid the COVID-19 pandemic: Students' perspectives," *Journal of Pedagogical Sociology and Psychology*, vol. 2, no. 1, pp. 45–51, 2020, doi: 10.33902/JPSP.2020261309.

[25] J. König, D. J. Jäger-Biela, and N. Glutsch, "Adapting to online teaching during COVID-19 school closure: Teacher education and teacher competence effects among early career teachers in Germany," *European Journal of Teacher Education*, vol. 43, no. 4, pp. 608–622, 2020, doi: 10.1080/02619768.2020.1809650.

[26] N. Cavus, "Distance learning and learning management systems," *Procedia — Social and Behavioral Sciences*, vol. 191, pp. 872–877, 2015, doi: 10.1016/j.sbspro.2015.04.611.

[27] A. G. Picciano, "Theories and frameworks for online education: Seeking an integrated model," *Online Learning*, vol. 21, no. 3, pp. 166–190, 2017, doi: 10.24059/olj.v21i3.1225.

[28] D. Turnbull, R. Chugh, and J. Luck, "Transitioning to E-learning during the COVID-19 pandemic: How have higher education institutions responded to the challenge?" *Education and Information Technologies*, vol. 26, pp. 6401–6419, 2021, doi: 10.1007/s10639-021-10633-w.

[29] N. Dabbagh and A. Kitsantas, "Personal learning environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning," *Internet and Higher Education*, vol. 15, no. 1, pp. 3–8, 2012, doi: 10.1016/j.iheduc.2011.06.002.

[30] J. Biggs and C. Tang, *Teaching for Quality Learning at University*, 4th ed. McGraw-Hill / Society for Research into Higher Education & Open University Press, 2011.

[31] B. Means, Y. Toyama, R. Murphy, and M. Baki, "The effectiveness of online and blended learning: A meta-analysis of the empirical literature," U.S. Department of Education, Office of Planning, Evaluation, and Policy Development, Tech. Rep., 2013, eD542084.