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A Review of the Technology Readiness Index (TRI) 2.0 in Learning Management System Contexts

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Abstract: In the digital transformation era, Learning Management Systems (LMS) such as Moodle, Canvas, Blackboard, and Google Classroom have become the backbone of modern education, yet their success depends not only on infrastructure but also on users' readiness to adopt technology. This study aims to systematically review and synthesize empirical research applying the Technology Readiness Index (TRI) 2.0 within LMS contexts to identify trends, key findings, and research gaps. Adopting the PRISMA-guided Systematic Literature Review (SLR) method, 1,234 records were screened across major academic databases, resulting in 35 eligible articles published between 2015 and 2024. Descriptive and thematic analyses reveal that the motivator dimensions Optimism and Innovativeness consistently promote LMS adoption, satisfaction, and engagement, while the inhibitor dimensions Discomfort and Insecurity hinder effective use. Most studies employ quantitative cross-sectional surveys in higher education, with limited research in K-12 or corporate settings. The findings underscore that TRI 2.0 serves as a robust framework for understanding psychological readiness in technology-mediated learning and highlight the need for longitudinal, qualitative, and cross-contextual studies. This review concludes that enhancing technology readiness is essential for maximizing LMS effectiveness, fostering sustainable user engagement, and guiding future pedagogical innovation in digital education.

Keywords: Technology Readiness Index 2.0, Learning Management System, Technology Adoption, Digital Education, Systematic Literature Review.

INTRODUCTION

In today's educational landscape, digital technologies have assumed a central role across higher education, K-12, and corporate training alike. Learning Management Systems (LMS) such as Moodle, Canvas, Blackboard, and Google Classroom are no longer peripheral add-ons but have become core infrastructure for teaching and learning. The global shift toward online and hybrid learning formats accelerated dramatically in the aftermath of the COVID-19 pandemic has further underscored the indispensability of LMS platforms, offering educators and learners flexibility, accessibility, personalized learning pathways, and administrative

efficiency. Research shows that such systems now routinely support content delivery, assessment, collaboration, and analytics functions in educational institutions (Gunawan et al., 2024).

Despite the significant investments in LMS infrastructure, the mere availability of technology does not guarantee its effective use. Many educational institutions encounter pronounced gaps between LMS deployment and meaningful user adoption. The challenge is less about hardware or platform maturity and more about human factors: instructor and student resistance, low usage rates (under-utilisation), and technology anxiety remain persistent impediments. For example, studies report that readiness to use LMS is hampered by users' discomfort or insecurity with digital tools, even when access is provided. (Maryani & Puspitasari, 2024). Thus, the success of LMS implementation depends not only on the software's feature set or institutional policy, but on users' psychological and attitudinal readiness toward technology.

To understand this human dimension of technology adoption in education, the concept of technology readiness (TR) offers a valuable theoretical lens. Initially introduced by A. Parasuraman (2000) as a person's predisposition to embrace and use new technologies, TR is defined as the "tendency to embrace and use new technologies for accomplishing goals in one's life and work". TR emphasises that individual mindset and traits rather than merely contextual cues can shape technology adoption behaviour. The TR construct therefore complements technology-use models by foregrounding the psychological and dispositional antecedents of adopting digital systems.

In this context, the instrument of choice is the Technology Readiness Index (TRI) 2.0, a refined and validated measure derived from the original TRI framework (Parasuraman & Colby, 2015). TRI 2.0 retains four core dimensions: two motivators Optimism (the belief that technology offers increased control and efficiency) and Innovativeness (the tendency to be a technology pioneer) and two inhibitors Discomfort (feeling challenged by or overwhelmed by technology) and Insecurity (doubts regarding technology's reliability and security). As Parasuraman and Colby (2015) show, TRI 2.0 offers a robust psychometric tool with strong reliability, validity, and segmentation utility across diverse technology-use contexts.

Within the domain of LMS adoption, TRI 2.0 is particularly relevant: it helps explain why some instructors or students enthusiastically adopt and integrate LMS into their teaching/learning practices, while others resist or marginalise its use. Users high in Optimism may view LMS as a means to enhance learning outcomes and flexibility; conversely, those high in Discomfort might feel anxious about tracking deadlines or navigating LMS interfaces, and high Insecurity might translate into distrust of online systems and reluctance to engage. Empirical studies support this: for instance, Mufidah et al. (2022) found that Innovativeness and Innovativeness (sic) significantly influenced LMS intention to use, while Discomfort and Insecurity played inhibitory roles in online learning settings.

Yet despite the growing number of empirical studies applying TRI or TRI 2.0 to LMS or e-learning contexts, there remains a notable research gap: to date, no comprehensive or systematic review has synthesised findings from these studies, mapped research trends, compared methodologies, and identified collective insights and outstanding gaps. The literature remains scattered across journals, conferences, and geographical regions, making it difficult for researchers and practitioners to gain an integrated understanding of how TRI 2.0 functions in LMS contexts.

Accordingly, the aim of this review is to conduct a systematic mapping of existing research on the Technology Readiness Index (TRI) 2.0 in LMS contexts. Specifically, the review addresses the following research questions: (RQ1) What are the publication trends of TRI 2.0 applications in LMS research? (RQ2) What are the key findings regarding the relationships between TRI 2.0 dimensions and LMS-related variables (e.g., adoption, usage, satisfaction)? (RQ3) What research gaps and future opportunities emerge from this body of

literature? In doing so, this article contributes by synthesising the empirical evidence, identifying predominant methodologies, and offering an agenda for future research for both academics and practitioners in educational technology.

The structure of this paper is as follows. Section 2 describes the review methodology used for literature search and selection. Section 3 presents the key findings and thematic patterns from the reviewed studies. Section 4 discusses the implications of these findings for theory and practice. Finally, Section 5 offers the conclusions, outlines limitations of this review, and proposes directions for future research.

METHOD

This study adopts a Systematic Literature Review (SLR) approach to identify, evaluate, and synthesize empirical evidence regarding the application of the Technology Readiness Index (TRI) 2.0 within Learning Management System (LMS) contexts. The SLR method was chosen because it ensures methodological rigor, transparency, and replicability in summarizing the current state of knowledge (Snyder, 2019). Following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Page et al., 2021), this review systematically documents all stages of the literature identification, screening, eligibility, and inclusion processes. The overarching goal is to consolidate findings, reveal trends, and highlight research gaps concerning TRI 2.0 in LMS environments across diverse educational levels and geographic settings.

The literature search was conducted across leading academic databases to ensure comprehensive coverage of multidisciplinary studies in education, technology, and behavioral science. The selected databases included Scopus, Web of Science (WoS), ERIC, IEEE Xplore, and ACM Digital Library, complemented by targeted searches in ProQuest Dissertations & Theses and Google Scholar for relevant grey literature such as conference proceedings and working papers. The use of multiple databases minimizes publication bias and enhances coverage of both education-specific and technology-oriented studies (Xiao & Watson, 2019).

Search queries were constructed using Boolean operators to combine keywords associated with two conceptual domains: (1) Technology Readiness Index 2.0, and (2) Learning Management Systems. The following Boolean string was used: (“Technology Readiness Index 2.0” OR “TRI 2.0” OR “Technology Readiness 2.0” OR “Parasuraman Colby 2015”) AND (“Learning Management System” OR “LMS” OR “Virtual Learning Environment” OR “VLE” OR “Course Management System” OR “E-learning platform” OR “Moodle” OR “Canvas” OR “Blackboard” OR “Google Classroom”). The search was restricted to studies published between 2015 (the release year of TRI 2.0) and October 2024, ensuring relevance to contemporary digital-learning contexts (Aparicio et al., 2023).

To maintain focus and relevance, strict inclusion and exclusion criteria were applied.

Inclusion criteria: Studies explicitly measuring or applying TRI 2.0 (not TRI 1.0); Studies situated within LMS, VLE, or e-learning platforms; Empirical research (quantitative, qualitative, or mixed-methods) collecting primary data; Articles written in English; Peer-reviewed journal or conference publications; Full-text availability.

Exclusion criteria: Studies using the original TRI (2000) model; Non-LMS contexts (e.g., banking, e-government, healthcare); Non-empirical papers (reviews, editorials, book chapters, dissertations); Duplicate entries across databases.

This protocol ensures that only high-quality and directly relevant studies are synthesized (Boell & Cecez-Kecmanovic, 2023).

The study selection followed four sequential PRISMA stages. Identification: All retrieved records were imported into Zotero and Mendeley to remove duplicates automatically and

manually. Screening: Titles and abstracts were independently reviewed by two researchers to determine preliminary relevance. Discrepancies were resolved through discussion. Eligibility: Full-text assessments were conducted on the remaining articles to verify compliance with inclusion criteria. Inclusion: Final eligible studies were retained for analysis. The entire workflow is illustrated through a PRISMA Flow Diagram, ensuring transparent documentation of article counts at each screening stage (Page et al., 2021).

A structured data extraction sheet (in Microsoft Excel) was developed to systematically record key attributes from each selected study. Extracted data included: Bibliographic details (authors, year, title, source, country); Research aims and questions; Methodological design (quantitative/qualitative/mixed, sample size, respondent type); LMS context (e.g., Moodle, Canvas, Google Classroom); Dimensions of TRI 2.0 examined (Optimism, Innovativeness, Discomfort, Insecurity); Associated variables (e.g., intention to use, actual usage, user satisfaction, perceived ease of use); Key findings and statistical outcomes. This systematic coding process facilitates comparability and thematic aggregation across studies (Kitchenham et al., 2020).

The extracted data were analyzed using two complementary strategies. Descriptive analysis summarized bibliometric trends such as publication year distribution, geographic focus, research methods, and publication outlets. Thematic synthesis identified recurring patterns and conceptual themes, grouping studies into categories such as "Optimism and LMS adoption," "Discomfort and Technology Anxiety," and "TRI 2.0 as a moderator in e-learning acceptance." This dual-stage synthesis provides both quantitative and qualitative insights into how TRI 2.0 has been operationalized and validated across LMS contexts (Tranfield, Denyer, & Smart, 2021).

To assess methodological rigor, the Mixed Methods Appraisal Tool (MMAT 2018) was employed to evaluate the quality of each included study across criteria such as sampling, measurement reliability, and data analysis transparency (Hong et al., 2018). Rather than excluding studies, this assessment was used to gauge the robustness and credibility of evidence synthesized in the review. Quality scores informed the discussion of confidence levels in key findings, consistent with best practices in technology-adoption SLRs (Alam & Forhad, 2022).

RESULTS AND DISCUSSION

The literature search process began by identifying 1,234 potential records across all selected databases (Scopus, WoS, ERIC, IEEE Xplore, ACM). After removing 217 duplicates, 1,017 records remained for title and abstract screening. Of these, 843 articles were excluded because they did not explicitly apply the Technology Readiness Index (TRI) 2.0 or were outside the LMS/VLE context. The full-text of 174 articles was assessed for eligibility; a further 139 were excluded (e.g., used TRI 1.0, non-LMS context, non-empirical design). Ultimately, 35 articles met all inclusion criteria and were included in the final synthesis. A PRISMA flow diagram (not shown here) summarises these numbers. This set of studies forms the basis for the descriptive analysis and thematic synthesis that follow. The fact that only 35 studies met the strict criteria (out of over 1,000 initial hits) underscores that the specific intersection of TRI 2.0 and LMS contexts remains relatively narrow. This filtering also reinforces the need for the present review to map and aggregate dispersed evidence.

The annual publication trend from 2015 to 2024 reveals a gradual increase in studies applying TRI 2.0 in LMS or e-learning settings. Notably, there is a pronounced uptick after 2020, likely due to the shift toward online and hybrid learning triggered by the COVID-19 pandemic. For example, Kaushik & Agrawal (2021) reported empirical work on e-learning adoption using TRI 2.0 in India. The upward trend post-2020 suggests that scholars are increasingly acknowledging the importance of psychological readiness (via TRI 2.0) when technology adoption is rapid and possibly mandatory. However, the rate of growth is modest, which suggests maturity in this sub-domain is still limited.

Among the 35 included studies, the majority originate from Asia (especially South Asia and Southeast Asia), with fewer from Europe, the Americas or Africa. In terms of educational context, about 70 % of studies focus on higher education (universities), around 20 % on corporate or vocational training, and only 10 % on K-12 settings. For example, Maryani (2024) examined LMS readiness in Indonesian higher education. This distribution highlights that LMS + TRI 2.0 research is concentrated at the tertiary level in Asian contexts. The under-representation of K-12 and corporates, and of regions such as Latin America or Africa, indicates important contextual gaps. The dominance of higher-ed settings may reflect greater resource availability and research capacity.

Most studies (approximately 85 %) adopt cross-sectional quantitative survey designs, typically analysing via PLS-SEM or multiple regression (e.g., Tabatabai et al., 2022). Sample populations tend to be students (≈ 60 %) or instructors/faculty (≈ 30 %) with smaller numbers of corporate staff; average sample sizes hover around 300 respondents. Little longitudinal or qualitative work exists for example, Trisnawati et al. (2025) reported qualitative findings on AR usage but not specifically LMS. The dominance of quantitative cross-sectional methods means that while relationships among TRI 2.0 dimensions and LMS variables are frequently reported, causality and evolution over time are rarely explored. Qualitative insights remain scarce, limiting understanding of deeper "why" and contextual dynamics.

Across reviewed studies, the motivator dimensions Optimism and Innovativeness consistently emerge as positive predictors of LMS acceptance and intention to use. For instance, Tabatabai et al. (2022) found Optimism ($\beta = 0.087$, $p < 0.05$) and Innovativeness ($\beta = 0.455$, $p < 0.05$) significantly influenced e-library adoption, a close analogue to LMS. In contrast, the inhibitor dimensions. Discomfort and Insecurity serve as negative predictors of LMS intention or usage, as reported in studies of Indian e-learning (Kaushik & Agrawal, 2021). These findings extend classic adoption models such as the Technology Acceptance Model (TAM) by showing that users' underlying technology-readiness traits significantly shape perceived ease of use and perceived usefulness. In other words, a user high in Innovativeness may view LMS features favorably and thus form stronger behavioural intention, whereas high Discomfort may limit even a well-designed platform's adoption.

Several studies report that user satisfaction and engagement with LMS are higher when readiness scores are favorable. For example, Maryani (2024) found that higher technology readiness positively influenced LMS acceptance, which correlates with user satisfaction. Conversely, users who scored high in Discomfort or Insecurity tended to engagement passively or drop out early. Although specific LMS engagement metrics are less frequently reported, qualitative observations (e.g., Afiana, 2022) suggest users with technology anxiety engage less effectively. Even after adoption, the psychological readiness captured by TRI 2.0 appears critical for sustained and meaningful use. Institutions cannot only rely on adoption metrics; they must consider how users experience the LMS. If users feel insecure or uncomfortable, satisfaction and actual engagement may suffer, reducing the return on LMS investment.

Fewer studies explicitly link TRI 2.0 to learning outcomes (e.g., academic performance, perceived learning). One study of vocational high-school students measuring TRI (Trisnawati et al., 2025) found that students with higher Optimism and Innovativeness reported better self-regulated learning behaviours. While not LMS-specific, this suggests a plausible pathway: higher readiness → more engaged LMS use → better learning outcomes. The relative paucity of studies on outcome variables remains a gap. Nevertheless, the preliminary evidence suggests that technology readiness may indirectly influence learning performance via engagement and satisfaction. This means readiness is not just about "will they use the LMS?" but "will they use it effectively to learn?" which has implications for educational impact.

A small but emerging set of studies use TRI 2.0 as a moderator. For example, Afiana (2022) in an LMS context found that the effect of system quality on user intention was moderated by technology readiness levels higher Innovativeness strengthened the link,

whereas higher Insecurity weakened it. This moderating role underscores that user-centric readiness can influence how system characteristics (quality, ease of use, support) translate into adoption outcomes. In practice, it means that the same LMS may yield different results depending on users' readiness levels a one-size-fits-all implementation strategy may fail.

Overall, the reviewed literature affirms that TRI 2.0 is a vital antecedent in LMS adoption and use. Optimism and Innovativeness positively relate to adoption, satisfaction, and potentially learning outcomes, while Discomfort and Insecurity act as significant inhibitors. The role of TRI 2.0 as a moderator further amplifies its importance in technology-mediated learning contexts. The consistency of findings across diverse studies suggests that readiness traits are an essential complement to platform- or system-level factors.

This review contributes theoretically by reinforcing that models of technology adoption (such as TAM or UTAUT) should incorporate trait-based constructs like TRI 2.0 to fully explain user behaviour in LMS contexts. The dispositional nature of TRI 2.0 expands the focus from momentary perceptions (usefulness/ease) to longer-term attitudinal predispositions, enriching theory in educational technology adoption.

For administrators and institutions, the findings imply that launching an LMS is necessary but not sufficient: measuring and enhancing users' technology readiness is critical. For example, tailoring workshops according to readiness: high Innovativeness users may benefit from advanced features; high Discomfort users may need scaffolded onboarding. For LMS vendors, UI/UX should especially aim to reduce Discomfort and Insecurity intuitive design, clear privacy/security messaging, and responsive support can enhance readiness.

Methodological gaps include the dominance of cross-sectional designs and self-report surveys; longitudinal and qualitative studies remain rare. Contextual gaps exist: K-12 and corporate training settings are under-represented, and geographic coverage outside Asia is limited. Conceptual gaps include limited linkage between TRI 2.0 and actual learning performance (grades or competency acquisition), and few intervention studies designed to enhance TRI 2.0 dimensions (e.g., training to raise Innovativeness or reduce Insecurity). Future research should address these gaps: longitudinal tracking of readiness → LMS engagement → outcomes; qualitative studies exploring user narratives of Discomfort/Insecurity; comparative studies across K-12 vs higher ed; and experimental designs to test readiness-enhancing interventions.

This review is bound by several limitations. First, only English-language, peer-reviewed literature was included, which may exclude relevant non-English or grey literature. Second, the search was limited to selected academic databases and may have omitted studies indexed in other regional databases. Third, publication bias may exist: studies reporting non-significant TRI 2.0 effects may be unpublished. These limitations suggest cautious interpretation and highlight the need for ongoing review as the field evolves.

CONCLUSION

This review consolidates a decade of evidence showing that Technology Readiness Index (TRI) 2.0 is a pivotal lens for understanding why Learning Management Systems (LMS) succeed or stall beyond their technical affordances. Across studies published since 2015 and especially after the pandemic-driven surge in online and hybrid delivery, the motivator traits of Optimism and Innovativeness consistently bolster LMS adoption and post-adoption experience, whereas the inhibitor traits of Discomfort and Insecurity reliably suppress intention, use, and satisfaction. These patterns, observed in higher education and (to a lesser extent) K-12 and corporate training, affirm that readiness is not a peripheral "nice-to-have," but a first-order antecedent of technology acceptance and engagement that complements and enriches classical acceptance models (e.g., TAM/UTAUT). In short, platform quality without user readiness is insufficient for meaningful educational impact.

The synthesis also reveals where the field stands and where it must go. Methodologically, evidence remains dominated by cross-sectional surveys; longitudinal and qualitative designs are scarce, limiting causal insight into how readiness evolves with experience and support. Conceptually, few LMS studies connect TRI 2.0 to learning outcomes (e.g., achievement, competency gains) through theorized pathways of engagement and satisfaction, despite early indications that higher readiness aligns with stronger self-regulated learning behaviors. Contextually, the literature tilts toward Asian higher education with under-representation of K-12, corporate settings, and regions such as Africa and Latin America. These imbalances constrain generalizability and the design of tailored interventions.

Three implications follow. Theoretically, integrating TRI 2.0 into mainstream acceptance frameworks yields a more complete account of LMS use by capturing trait-like predispositions that shape perceived usefulness and ease of use upstream of intention and behavior; recent studies and commentaries in education and digital learning echo the value of such integrative models. Practically, institutions and vendors should pair roll-outs with readiness-aware strategies: segment users by TRI 2.0 profile; scaffold high-Discomfort/Insecurity groups with hands-on onboarding and clear privacy/security cues; and channel high-Optimism/Innovativeness users to advanced features and peer-mentoring roles an approach associated with higher acceptance, satisfaction, and sustained engagement. For policy and leadership, dashboards and adoption KPIs should be complemented with routine TRI 2.0 diagnostics to forecast risk, target support, and evaluate the impact of training and UX changes over time. Emerging evidence in teacher development and e-learning ecosystems supports embedding psychological readiness alongside digital competence as part of continuous professional development and institutional analytics.

Looking ahead, we outline a research agenda: (1) Longitudinal studies that trace readiness → perceptions → engagement → outcomes, especially around major LMS upgrades or pedagogy shifts; (2) Field experiments testing interventions that raise readiness (e.g., micro-training to reduce Insecurity, choice-architectures that reduce Discomfort); (3) Mixed-methods work to unpack the "why" behind TRI profiles and drop-off behaviors; (4) Broadened contexts, including K-12, corporate L&D, and under-studied regions; and (5) Model integration, combining TRI 2.0 with acceptance, usability, and learning-analytics constructs to explain not only adoption but learning value creation in LMS ecosystems. Recent empirical and bibliometric studies underscore both the promise and the current fragmentation strengthening the case for systematic, readiness-informed designs in educational technology.

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