The Role of MOOCs-Based Learning Environment Support in Enhancing Self-Regulated Learning for Sustainable Education (SDG 4): Evidence from Hope School, Southwest Jiaotong University

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ABSTRACT:

This study aims to examine the role of Massive Open Online Courses (MOOCs)-based learning environment support in enhancing self-regulated learning (SRL) among postgraduate students, with particular emphasis on contributing to sustainable and inclusive education aligned with Sustainable Development Goal 4 (Quality Education). The study addresses persistent challenges in outdated teaching management systems and high dropout rates in online learning environments.

To provide a comprehensive explanation, the research integrates Zimmerman's self-regulated learning framework with the Expectation Confirmation Model (ECM) in order to capture both cognitive and system-related mechanisms underlying successful online learning. A quantitative research design was employed, with data collected from postgraduate students at Hope School, Southwest Jiaotong University. The data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM).

The findings indicate that high-quality learning environment support particularly in terms of system quality, accessibility, and ease of use has a significant positive effect on expectation confirmation and learner satisfaction. These factors act as key mediators in enhancing self-regulated learning competencies, including goal setting, progress monitoring, and self-reflection. Furthermore, the results highlight that well-designed MOOCs environments can support equitable access to learning and promote lifelong learning capabilities, which are essential components of sustainable education.

The study contributes both theoretically and practically by proposing a dual strategy that integrates technological system enhancement with the development of learners' self-regulatory capacities. This approach provides a pathway for higher education institutions to strengthen sustainable digital learning ecosystems

and advance the achievement of SDG 4 in postgraduate education.

Keywords: MOOCs; self-regulated learning; learning environment; expectation confirmation model; sustainable education; SDG 4; postgraduate education

Introduction

The transition toward a digital society has accelerated the need for higher education institutions worldwide to adapt their teaching and learning practices to align with the demands of 21st-century education. In particular, the integration of digital technologies has played a crucial role in enhancing instructional flexibility and expanding access to educational opportunities. Massive Open Online Courses (MOOCs) have been widely recognized as an educational innovation that reduces temporal and spatial constraints, facilitates access to advanced knowledge, and promotes lifelong learning (Hew & Cheung, 2014). In the context of postgraduate education, MOOCs have increasingly been adopted as a complementary mechanism to support deep learning, research engagement, and the development of advanced academic competencies within highly flexible learning environments.

Despite their strong technological and structural potential, a growing body of research indicates that sustained learner engagement and learning outcomes in MOOCs remain below expectations. Recent studies suggest that learner engagement is increasingly influenced by adaptive digital learning environments and intelligent educational support systems capable of responding to individual learning needs (Yang et al., 2025). This challenge is particularly pronounced at the postgraduate level, where learners must manage complex academic workloads while exercising a high degree of autonomy in their learning processes. These findings suggest that the success of MOOCs-based learning does not depend solely on technological efficiency; rather, it is contingent upon the design of learning environments that effectively support deep learning processes and foster learners' developmental capacities.

The concept of self-regulated learning (SRL) provides a theoretical explanation for how effective learners are able to systematically set goals, plan learning activities, monitor progress, and evaluate learning outcomes (Zimmerman, 2000). In open and flexible online learning environments such as MOOCs, SRL competence becomes a critical determinant of learners' persistence and academic achievement. Although prior studies have emphasized the importance of SRL in online learning contexts, there remains a lack of systematic explanation regarding the structural mechanisms that connect learning environment design with the development of learners' self-regulatory skills. From another perspective, the Expectation Confirmation Model (ECM) has been widely applied to explain users' continuance intention toward information systems, highlighting the roles of expectation confirmation and satisfaction in shaping sustained usage behavior (Bhattacherjee, 2001). While ECM has been employed in MOOCs-related research to explain learners' continuance intention, relatively few studies have integrated ECM with the SRL framework to elucidate how learners' perceptions of learning environment quality influence their cognitive and self-regulatory learning processes. Accordingly, this study seeks to address this research gap by examining the role of MOOCs-based learning environment support in fostering self-regulated learning among postgraduate students. By integrating Zimmerman's self-regulated learning theory with the Expectation Confirmation Model, this study aims to explain the mechanisms through which learning environment support contributes to successful online learning in higher education. The development of MOOCs-based learning environments in higher education is closely aligned with the objectives of Sustainable Development Goal 4 (Quality Education), which

emphasizes inclusive, equitable, and lifelong learning opportunities (United Nations, 2015). In this context, MOOCs provide flexible and scalable access to education, enabling learners to overcome geographical and institutional barriers while supporting continuous knowledge development. Importantly, the effectiveness of such digital learning systems depends not only on technological accessibility but also on learners' capacity for self-regulated learning (SRL), which allows them to manage goals, monitor progress, and sustain engagement in autonomous learning environments (Zimmerman, 2000). By integrating high-quality learning environment support with the development of SRL competencies, higher education institutions can enhance learner satisfaction, reduce dropout rates, and promote sustainable learning behaviors. Therefore, MOOCs-based learning systems can be viewed as a strategic mechanism for advancing SDG 4 through the creation of inclusive, adaptive, and sustainable digital education ecosystems (UNESCO, 2023).

Literature Review

1. The Concept of Self-Regulated Learning

Self-Regulated Learning (SRL) refers to a set of cognitive and behavioral

processes through which learners take an active role in controlling and directing their own learning. These processes include goal setting, planning, self-monitoring, strategy regulation, and self-evaluation (Zimmerman, 2000). Zimmerman's cyclical model of SRL conceptualizes learning as an ongoing and adaptive process consisting of three interrelated phases: the forethought phase, the performance and self-control phase, and the self-reflection phase. This model emphasizes that effective learning is not linear but iterative, with learners continuously adjusting their strategies based on feedback and prior learning experiences.

Similarly, Pintrich (2004) proposed a framework that highlights the roles of

motivation, value beliefs, and learning strategies within the SRL process. According to this perspective, self-regulation is not solely determined by cognitive abilities but is strongly influenced by learners' goal orientations, task value perceptions, and motivational beliefs. A substantial body of research has confirmed that SRL plays a critical role in online learning environments, where learners are required to assume a high level of responsibility for managing their own learning and receive limited direct, face-to-face guidance from instructors. Consequently, the development of SRL is widely recognized as a key mechanism underpinning successful online learning outcomes in higher education contexts.

2. MOOCs Learning Environments and Self-Regulated Learning

MOOCs learning environments are inherently complex systems that integrate

technological infrastructure, course design, learning resources, and online interaction mechanisms among learners, content, and instructors. The design and quality of these environments exert a direct influence on learners' learning behaviors, engagement levels, and persistence. Research by Kizilcec et al. (2017) demonstrated that MOOCs incorporating structured supports for goal setting, progress monitoring, and reflective activities can significantly enhance learners' self-regulated learning skills. Recent evidence further suggests that intelligent and AI-supported learning environments can strengthen self-directed learning by facilitating personalized learning pathways and adaptive information access (Islam et al., 2025).

In addition, Hew and Cheung (2014) emphasized that learner content

interaction, institutional support, and clearly structured course designs play a crucial role in facilitating deep learning within MOOCs. These findings suggest that MOOCs learning environments should not be viewed merely as platforms for content delivery. Rather, they function as "structural catalysts" that can actively foster the development of learners' self-regulated learning processes, particularly in contexts where

learners must engage in autonomous and sustained learning with minimal external supervision. Recent studies have further demonstrated that digital literacy functions as a critical mechanism enabling learners to effectively navigate technology-rich environments and develop self-regulatory capabilities. Learners with stronger digital literacy are more likely to manage learning tasks, adapt to technological demands, and sustain learning performance in digital environments (Pengfei et al., 2026).

3. Expectation Confirmation Model and Its Explanatory Role in the MOOCs Context

The Expectation Confirmation Model (ECM) explains continuance behavior

in information system usage through the comparison between users' pre-use expectations and their post-use experiences, which in turn influences satisfaction and continuance intention (Bhattacherjee, 2001). In the context of MOOCs, ECM provides a useful explanatory framework for understanding how learners' perceptions of learning environment quality and expectation confirmation affect their motivation, satisfaction, and willingness to invest time and effort in the learning process.

Recent studies in online learning suggest that the explanatory power of ECM

extends beyond continuance intention to encompass cognitive and learning-related processes. When learners are satisfied with the learning environment, they are more likely to set clear learning goals, employ appropriate learning strategies, and engage in ongoing self-evaluation core components of self-regulated learning (SRL). Reflective practices play a critical role in strengthening self-regulated learning, particularly in facilitating learners' ability to evaluate and adapt their learning strategies (Tseng et al., 2025). Therefore, integrating ECM with the SRL framework offers a systematic approach to explaining the linkage between MOOCs learning environment design and learners' deep, self-regulated learning processes. This integrated perspective provides a more comprehensive understanding of how technological and psychological mechanisms jointly contribute to successful online learning outcomes.

Research Significance

The integration of digital technologies into teaching and learning in higher education represents not merely a technical adjustment but a structural transformation that significantly influences learning quality and the effectiveness of educational management. This transformation is particularly critical at the graduate level, where learners require learning environments that support advanced knowledge construction, research development, and high-level academic competencies. Although Massive Open Online Courses (MOOCs) have been widely adopted as a key mechanism for expanding access to higher education, their implementation in practice continues to face challenges related to low persistence and high dropout rates. These issues indicate limitations that extend beyond technological concerns alone.

The first major issue relates to institutional and system-level constraints. In many higher education contexts, including Hope College of Southwest Jiaotong University, the adoption of MOOCs remains dependent on learning support systems and data management structures that are misaligned with the flexible and learner-centered nature of online learning. As a result, learning resource management lacks systematic integration, system usability is often complex, and learning analytics data cannot be effectively leveraged for in-depth monitoring and evaluation of learning processes. These constraints significantly diminish the potential of MOOCs to genuinely support graduate-level learning. The second key issue concerns challenges related to learners' self-regulatory capacity. Graduate students are required to exercise a high level of self-regulated learning skills to manage complex academic tasks. Even when diverse online learning resources are available, learners may fail to fully benefit from MOOCs if the learning environment does not adequately support motivation, self-efficacy, and sustained engagement. This challenge highlights the

necessity of designing learning environments that not only facilitate content access but also actively support deep learning processes and the development of self-regulated learning skills in parallel.

The final issue addresses theoretical and practical gaps in existing research. Prior studies have largely focused on explaining MOOCs usage behavior or information system adoption, with a predominant emphasis on undergraduate learners rather than graduate students, whose learning contexts and needs differ substantially. This study is therefore significant in addressing this gap by integrating the Expectation–Confirmation Model (ECM) with Self-Regulated Learning theory to systematically explain the relationship between learning environment design and learners' cognitive and learning processes.

The findings of this study contribute not only to theoretical advancement by extending explanatory frameworks for online learning behavior but also offer important practical and policy implications. Specifically, the study proposes a dual strategic approach that simultaneously enhances the effectiveness of learning systems and strengthens learners' self-regulated learning capacities, thereby supporting the development of high-quality and sustainable online learning environments at the graduate level.

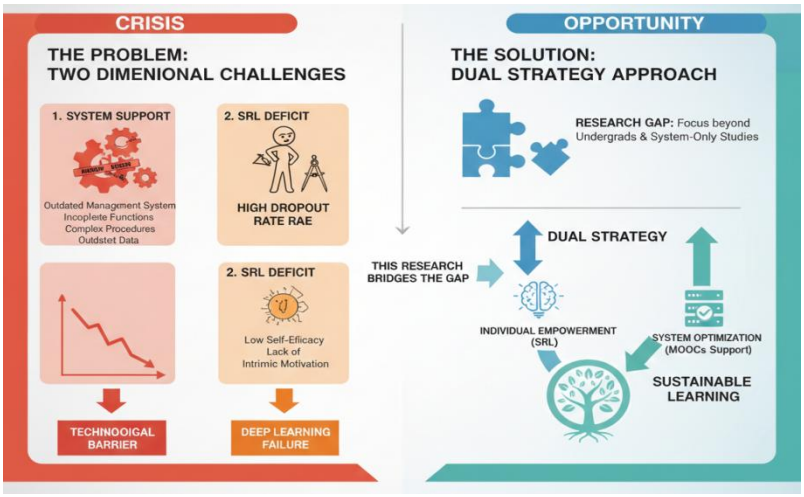

Figure 1. A Framework of the Dual Strategy Approach for Enhancing MOOC-Based Self-Regulated Learning in Postgraduates.

Research Framework

Based on a synthesis of relevant literature and theoretical foundations, this study develops a research framework to explain the structural relationships between MOOCs-based learning environment support and the self-regulated learning (SRL) processes of graduate students. The framework emphasizes the psychological mechanisms that link external support factors embedded in technological systems with learners' internal learning competencies.

The proposed framework is grounded in the central assumption that the provision of an effective MOOCs-based learning environment by higher education institutions particularly in terms of instructional management system stability, content quality, and ease of access to learning resources directly influences learners' perceptions of the extent to which the learning environment meets their educational expectations. This perceptual mechanism is explained through the Expectation–Confirmation Model (ECM), which posits that post-use confirmation of expectations is a critical antecedent of satisfaction with a learning system.

In the context of this study, satisfaction is not conceptualized merely as an attitudinal outcome but functions as a key mediating variable that transmits the effects of learning environment support to learners' self-regulated learning

processes. Specifically, when learners experience satisfaction with the support provided by the MOOCs system, this condition enhances intrinsic motivation and encourages greater engagement in self-regulated learning behaviors, such as setting clear learning goals, continuously monitoring and evaluating learning progress, and reflecting on learning outcomes to adapt learning strategies accordingly. Intelligent learning systems powered by big data and deep learning technologies can effectively monitor learning progress and enhance learner engagement in online environments (Yang et al., 2025).

Accordingly, this research framework represents a systematic and dynamic linkage between structural support factors at the institutional level and the enhancement of deep learning competencies at the individual learner level. The framework provides a robust basis for the formulation of research hypotheses and the examination of causal relationships using structural equation modeling techniques.

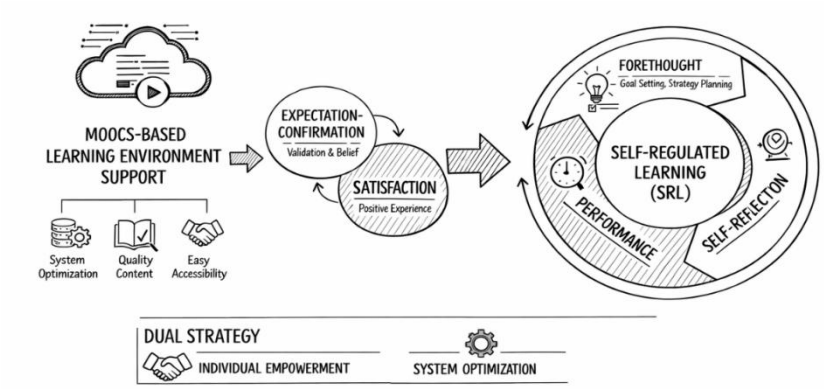

Figure 2. Conceptual Framework of the Study

Research Methodology

This study employed a quantitative research design. The sample consisted of graduate students enrolled in courses that integrated Massive Open Online Courses (MOOCs) at Hope School, Southwest Jiaotong University. The research instrument was a structured questionnaire developed based on relevant literature. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM), which is appropriate for examining complex relationships among latent variables and for predictive-oriented analysis (Hair et al., 2021).

Research Findings

Based on the quantitative data analysis using Structural Equation Modeling (SEM) to examine the relationships among variables proposed in the research framework, the following findings were identified:

1. **Effects of MOOCs-Based Learning Environment Support.** MOOCs- based learning environment support, as reflected by information system quality and information quality, exerted a statistically significant positive effect on expectation confirmation and satisfaction among graduate students. This finding suggests that a stable and easily accessible learning environment serves as a foundational antecedent that fosters learners' positive perceptions of online learning.

2. **Mediating Role of Satisfaction.** The analysis of indirect effects revealed that satisfaction functioned as a significant mediator between MOOCs-based learning environment support and the level of self-regulated learning (SRL). Specifically, learners' perceptions that the learning environment met their educational expectations led to higher levels of satisfaction, which in turn contributed to the overall enhancement of their self-regulated learning.

3. **Relationships with Core Components of Self-Regulated Learning.** Finally, the empirical findings indicated that MOOCs-based learning environment support was positively associated with the core components of self-regulated

learning, including goal setting, self-monitoring, and self-reflection. Graduate students who perceived the learning environment as having a clear structure, effective progress-tracking tools, and appropriate feedback mechanisms were significantly more likely to demonstrate higher levels of self-regulated learning behaviors.

Discussion

The findings of this study confirm that systematically designed and well-managed MOOCs-based learning environment support plays a critical mechanistic role in enhancing self-regulated learning (SRL) among graduate students. The discussion of these findings can be articulated through the following key points.

First, the results indicate that learning environment support does not exert a direct influence on learners' self-regulatory behaviors. Instead, its effects are mediated through cognitive mechanisms, specifically expectation confirmation and satisfaction. This pathway reflects the distinctive characteristics of graduate students, who typically exhibit a high degree of learning autonomy and are inclined to modify their deep learning behaviors only when they perceive that the MOOCs environment genuinely meets their academic needs. This finding extends the explanatory scope of the Expectation Confirmation Model (ECM) beyond its traditional focus on continued system usage to encompass the enhancement of learning process quality. Second, the MOOCs-based learning environment functions as a form of instructional scaffolding that supports learners during the performance phase of self-regulation. System features characterized by clear structure and tangible representations of learning progress help reduce cognitive load associated with managing information and learning procedures. As a result, learners are able to allocate greater cognitive resources to comprehending and critically analyzing academic content, thereby improving learning effectiveness.

Third, from an institutional perspective, the integration of teaching information management systems with MOOCs platforms helps mitigate structural barriers that often impede online learning. When the learning environment is well-organized and easily accessible, learners are more likely to engage in self-reflection and adaptive strategy adjustment, which are indicative of advanced levels of self-regulated learning.

Finally, the positive relationship between satisfaction and self-regulated learning highlights the role of intrinsic motivation as a key mechanism sustaining self-regulatory behaviors. Positive affective experiences within the learning environment facilitate the transformation of extrinsic motivation into intrinsic motivation, which constitutes a foundational condition for deep and sustainable learning in graduate education contexts.

Recommendations

1. Practical Recommendations

1.1 System Integration of Teaching Information Management.

Universities should prioritize upgrading teaching information management systems to ensure seamless integration with MOOCs platforms. Reducing technological barriers particularly complex access procedures and fragmented resource management can enhance expectation confirmation and learner satisfaction. A unified and up-to-date system infrastructure enables learners to perceive the learning environment as reliable and responsive to their academic needs.

1.2 Design of Cognitive Scaffolding Functions. MOOCs platforms should

incorporate features that explicitly support cognitive processes associated with self-regulated learning. Tools such as learning analytics dashboards that visualize learning progress can facilitate real-time self-monitoring and self-reflection among graduate students, thereby strengthening their capacity to regulate learning behaviors in flexible online environments.

1.3 Adoption of a Dual Strategy Approach. Institutions should avoid

focusing solely on technological development and instead adopt a dual strategy that combines

system enhancement with individual empowerment. Providing workshops or training programs on self-regulated learning (SRL) strategies can equip students with practical skills for goal setting, motivation regulation, and sustained engagement in highly flexible online learning contexts.

2. Recommendations for Future Research

2.1 Qualitative Deep-Dive Studies. Future studies should employ qualitative

approaches, such as in-depth interviews or focus group discussions, with learners exhibiting varying levels of self-regulated learning. Such methods can uncover intrinsic motivational factors and individual-level barriers that may not be fully captured through quantitative measures.

2.2 Comparative Studies across Academic Disciplines. Comparative

research examining self-regulated learning behaviors in MOOCs environments across disciplines such as humanities and social sciences versus science and technology would provide valuable insights. Differences in content structure and information management demands may lead to distinct SRL strategies among learners.

2.3 Experimental Research Designs. Experimental studies comparing

traditional MOOCs with MOOCs enhanced by self-regulation support tools (e.g., automated reminders or prompting questions) are recommended to empirically validate the effectiveness of environmental support features in significantly improving SRL outcomes.

2.4 Longitudinal Studies. Longitudinal research tracking learners' self-

regulated learning behaviors six months to one year after course completion is encouraged. Such studies would help determine whether the learning environments provided by universities contribute to the sustained development of lifelong learning habits.

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