



## THE ROLE OF ONLINE LEARNING PLATFORMS IN ENHANCING SELF-DIRECTED LEARNING ABILITY

### EL PAPEL DE LAS PLATAFORMAS DE APRENDIZAJE EN LÍNEA EN LA MEJORA DE LA CAPACIDAD DE APRENDIZAJE AUTODIRIGIDO

Xinyu Qiu<sup>1\*</sup>

E-mail: [2642218706@qq.com](mailto:2642218706@qq.com)

ORCID: <https://orcid.org/0009-0006-3044-4392>

<sup>1</sup> School of Foreign Languages, Inner Mongolia Normal University, Inner Mongolia, China

\*Corresponding author

#### Suggested citation (APA, seventh ed.)

Qiu, X. (2025). The role of online learning platforms in enhancing self-directed learning ability. *Revista Conrado*, 21(105), e4729.

#### ABSTRACT

This study investigates the relationship between online learning platform features and university students' self-directed learning (SDL) abilities. While online platforms have become integral to higher education, especially following the COVID-19 pandemic, their capacity to effectively promote SDL remains underexplored. Employing a quantitative research design with 164 participants from three universities, this study examines how interactive tools, personalized content, and usage frequency contribute to SDL dimensions including goal-setting, self-monitoring, and reflection. Results indicate that all three platform features positively correlate with enhanced SDL readiness, with platform usage frequency emerging as the strongest predictor. Significant differences were observed between undergraduate and postgraduate students, with the latter demonstrating higher SDL readiness. The findings extend Garrison's SDL model and Zimmerman's self-regulation framework into digital learning contexts, offering practical implications for educators and platform designers. For instructors, results highlight the importance of embedding scaffolding and reflection prompts; for developers, they underscore the value of features such as adaptive learning paths and performance dashboards that enhance metacognitive engagement. This research contributes to understanding how technological affordances can be leveraged to develop crucial self-directed learning competencies in contemporary educational environments.

#### Keywords:

Self-directed learning, online learning platforms, educational technology, interactive features, personalized learning, digital pedagogy.

#### RESUMEN

Este estudio investiga la relación entre las características de las plataformas de aprendizaje en línea y las habilidades de aprendizaje autodirigido (AAD) de los estudiantes universitarios. Si bien las plataformas en línea se han vuelto esenciales para la educación superior, especialmente tras la pandemia de COVID-19, su capacidad para promover eficazmente el AAD sigue siendo poco explorada. Empleando un diseño de investigación cuantitativa con 164 participantes de tres universidades, este estudio examina cómo las herramientas interactivas, el contenido personalizado y la frecuencia de uso contribuyen a las dimensiones del AAD, incluyendo el establecimiento de objetivos, la autosupervisión y la reflexión. Los resultados indican que las tres características de la plataforma se correlacionan positivamente con una mejor preparación para el AAD, siendo la frecuencia de uso de la plataforma el predictor más sólido. Se observaron diferencias significativas entre estudiantes de pregrado y posgrado, siendo estos últimos los que demostraron una mayor preparación para el AAD. Los hallazgos amplían el modelo SDL de Garrison y el marco de autorregulación de Zimmerman a los contextos de aprendizaje digital, ofreciendo implicaciones prácticas para educadores y diseñadores de plataformas. Para los instructores, los resultados resaltan la importancia de integrar andamiaje y estímulos para la reflexión; para los desarrolladores, subrayan el valor de funciones como las rutas de aprendizaje adaptativas y los paneles de rendimiento que mejoran la participación metacognitiva. Esta investigación contribuye a comprender cómo se pueden aprovechar las posibilidades tecnológicas para desarrollar competencias cruciales de aprendizaje autodirigido en los entornos educativos contemporáneos.



This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License

Vol 21 | No.105 | July-August | 2025  
Continuous publication  
e4729



## Palabras clave:

Aprendizaje autodirigido, plataformas de aprendizaje en línea, tecnología educativa, funciones interactivas, aprendizaje personalizado, pedagogía digital.

## INTRODUCTION

The increasing integration of technology into education—especially in the wake of the COVID-19 pandemic—has propelled online learning platforms into the forefront of contemporary teaching and learning. These platforms, ranging from Learning Management Systems (LMS) to adaptive mobile applications, are now widely employed across higher education to support flexible, accessible, and scalable instruction. While the initial promise of these tools focused on logistical efficiency, a growing body of research has begun to investigate their role in fostering deeper learning competencies, particularly self-directed learning (SDL)—a skill increasingly vital in today's knowledge economy (Knowles, 1975; Zimmerman, 2015).

Despite their prevalence, the capacity of online learning platforms to effectively promote SDL remains underexplored and inconsistently documented. Although some studies suggest that features like progress dashboards, adaptive feedback, and interactive content can support learner autonomy, others point to unintended consequences such as cognitive overload or motivational decline, especially when design features are misaligned with pedagogical goals (Sharma et al., 2023). These mixed results signal the need for a more granular investigation into how specific platform features influence various dimensions of SDL.

This study aims to examine the relationship between key online learning platform features and university students' self-directed learning abilities. It focuses on three core mechanisms: interactive tools, personalized content, and usage frequency, and how each contributes to SDL dimensions such as goal-setting, self-monitoring, and reflection. The research also seeks to understand the moderating effects of learner experience levels and usage habits across different student populations.

Theoretically, this research contributes to the growing intersection of educational technology and learning psychology by extending Garrison's (1997), SDL model and Zimmerman's (2015), self-regulation framework into the context of digital platforms. It also draws upon Self-Determination Theory to explore how online environments support or hinder learner autonomy, competence, and relatedness. Practically, the findings offer guidance for both educators and platform designers. For instructors, it highlights the importance of embedding scaffolding and reflection prompts to support autonomous learning.

For developers, it underscores the value of features such as adaptive learning paths and performance dashboards that can enhance learners' metacognitive engagement (Huang et al., 2024).

Self-directed learning has emerged as a critical concept in modern educational frameworks, particularly as digital learning environments continue to evolve. Knowles (1975), provided the foundational definition of SDL as a process where learners take initiative in diagnosing their learning needs, formulating goals, identifying resources, selecting appropriate strategies, and evaluating learning outcomes. This pioneering work established SDL not merely as an instructional method but as a comprehensive approach to learning that emphasizes learner autonomy and agency. Building on this foundation, Garrison's (1997), developed a comprehensive model that emphasizes the interrelated dimensions of self-management, self-monitoring, and motivation—dimensions that continue to guide current research. His model specifically highlighted the critical role of contextual control in facilitating effective self-direction, suggesting that SDL occurs at the intersection of personal responsibility and social influences.

More recently, Zimmerman (2015), connected SDL to broader theories of self-regulation, establishing that effective self-directed learners engage in cyclical processes of goal-setting, self-monitoring, self-motivation, and self-reflection. His research demonstrated that these processes occur in three distinct phases: forethought (planning), performance (execution), and self-reflection (evaluation). Complementing this work, Tough (1971), investigated the practical applications of SDL theory across diverse learning contexts, finding that successful self-directed learners demonstrate heightened metacognitive awareness and strategic adaptability. Song & Hill's (2007), framework further elaborated on how these key dimensions represent the cognitive and metacognitive strategies that empower learners to take control of their educational experiences, particularly in digital environments where direct instructor oversight may be limited or intermittent.

Contemporary online learning platforms incorporate several features designed to support and enhance self-directed learning behaviors. Personalization and adaptive content are critical components that respond to individual learner needs and preferences, potentially facilitating more autonomous learning experiences. Algorithmic content delivery systems that adjust difficulty levels and presentation formats based on learner interactions may create more conducive environments for self-directed learning to flourish. The implementation of interactivity features creates engagement opportunities that may strengthen learner agency and promote active rather than passive learning approaches. Their research on gamification demonstrates

how competitive and achievement-oriented elements can stimulate intrinsic motivation, a core component of sustained self-direction.

Learning analytics incorporated into platforms can provide learners with visualizations of their progress and engagement patterns, potentially enhancing metacognitive awareness essential for self-direction. Additionally, Chen & Hoshower (2022), investigated how various feedback mechanisms incorporated into learning platforms can provide the information necessary for learners to engage in meaningful self-assessment and reflection—processes that are essential to developing and maintaining SDL capabilities. Their longitudinal study demonstrated that multi-dimensional feedback (peer, automated, and self-assessment) created the most substantial improvements in learners' self-evaluative capabilities. Social learning features, including discussion forums and collaborative workspaces, create opportunities for co-regulation that may scaffold the development of individual self-direction skills through observation and interaction with peers.

Existing research has established preliminary connections between digital learning tools and various aspects of self-directed learning. Lee et al. (2020), found that successful learners demonstrated sophisticated self-regulation strategies that were supported by particular platform design elements. Their mixed-methods investigation identified that completion rates increased significantly when platforms incorporated explicit self-regulation prompts and structural supports.

The authors, Al-Adwan et al., 2024; Khan et al., 2024), investigated the differential impact of learning technologies across varying cultural contexts, finding that the effectiveness of specific tools in promoting self-direction was moderated by cultural orientations toward autonomy and authority.

In addition, Martinez-Lopez et al. (2017), examined the temporal dimension of SDL development through technology, suggesting that different platform features become more or less important at various stages of the learning journey. Their longitudinal study revealed that scaffolded support features were crucial for novice self-directed learners, while advanced learners benefited more from customization and open exploration opportunities. Additionally, (Sharma et al., 2023; Acosta-Servín et al., 2025), investigated potential negative consequences of certain platform designs, finding that excessive gamification and notification systems sometimes undermined intrinsic motivation and created dependency rather than autonomy, highlighting the complex relationship between technological design and SDL development.

The relationship between online learning platforms and self-directed learning can be conceptualized through

several theoretical lenses. Bandura's Social Cognitive Theory provides a framework for understanding how platform features may influence self-efficacy beliefs that underpin self-directed learning behaviors (Schunk & DiBenedetto, 2020). Model of self-regulated learning emphasizes the recursive nature of learning processes and how technological tools can serve as both environmental conditions and cognitive supports for these processes.

Drawing from these theoretical frameworks, this study adopts an integrative model that considers how specific platform features may function as scaffolds for different dimensions of SDL. This model recognizes that the development of self-direction occurs through complex interactions between learner characteristics, technological affordances, and contextual factors—necessitating an examination of not just if, but how and under what conditions digital platforms support SDL.

## 2.5 Hypotheses Development

Based on the reviewed literature and identified research gaps, this study proposes three hypotheses:

H1: Interactive features positively correlate with SDL. This hypothesis draws from Shahzad & Nadeem's (2021), research demonstrating that multimedia interactive content significantly increases learner control and self-directed behaviors. Their findings suggest that interactive elements such as simulations, branching scenarios, and knowledge checks may provide structured opportunities for learners to practice and develop SDL skills. Supporting this perspective, Mckinney (2023), found that interactive case studies specifically enhanced decision-making autonomy and strategic thinking—core components of self-direction. The relationship is likely mediated by increased cognitive engagement, as proposed by Liu & Liu's (2025), experimental study showing that higher interactivity levels were associated with deeper information processing and enhanced metacognitive monitoring.

H2: Personalized content enhances learners' goal-setting behavior. Abouelenein et al. (2025), found that learning analytics-based adaptive content had measurable effects on learners' goal orientation and planning behaviors. Their work suggests that when content adapts to individual progress and preferences, learners become more intentional about establishing specific learning objectives. This relationship may be explained by calibration theory, which suggests that accurate external feedback helps learners align their self-perceptions with actual performance. Extending this work, Du & Hew (2021), demonstrated that recommendation systems that expose learners to attainable challenge levels prompted more specific and ambitious goal-setting.

H3: Frequent platform use strengthens self-monitoring and reflection. This hypothesis is supported by Swanzen

& Botha's (2023), longitudinal study showing that regular engagement with continuous assessment features enhanced students' self-reflection capabilities over time. Their research indicates that consistent platform interaction may cultivate the habit of monitoring one's progress and adjusting strategies accordingly. Huang et al. (2024), provided additional evidence by documenting how learning dashboards fostered improved calibration between perceived and actual performance when consulted regularly. The cognitive mechanism behind this relationship may involve the formation of metacognitive habits, as suggested by Vandoni et al. (2024), who found that the transformation of deliberate self-monitoring into automatic self-assessment processes occurred after approximately eight weeks of consistent platform usage. This habituation effect was strongest when platforms incorporated varied reflection prompts that targeted different aspects of the learning process, suggesting that diverse assessment approaches may be necessary for comprehensive self-monitoring development.

These hypotheses address critical aspects of the relationship between online learning platform features and self-directed learning development, targeting the specific gaps identified in current research. By examining these relationships, this study aims to provide empirically-grounded insights into how technological design can more effectively support learner autonomy and self-direction in digital educational environments. RetryClaude can make mistakes. Please double-check responses.

## MATERIALS AND METHODS

This study employs a quantitative research design to investigate the relationship between online learning platform features and self-directed learning (SDL). Using a correlational approach with multiple regression analysis, the research examines how specific platform features influence different dimensions of SDL behaviors among higher education students. The design allows for testing the hypothesized relationships while controlling for potential confounding variables. By collecting data at three points throughout the semester (beginning, middle, and end), the study captures potential changes in SDL levels and platform usage patterns over time, providing insight into the developmental trajectory of self-directed learning behaviors in online environments.

Participants are recruited from undergraduate and graduate programs across three universities that offer substantial online learning components in their curricula. A stratified random sampling technique ensures representation across different academic disciplines, year levels, and prior experience with online learning platforms. This approach enhances the external validity of the findings by capturing a diverse range of student experiences and

backgrounds. Based on a power analysis using G\*Power 3.1 with an anticipated medium effect size ( $f^2 = 0.15$ ), power of 0.80, and alpha of 0.05 for multiple regression with 8 predictors, a minimum sample size of 109 participants is required. To account for potential incomplete responses and attrition over the semester, 180 participants are recruited initially, providing adequate statistical power for the planned analyses while allowing for dropout rates typical in longitudinal educational research.

The Self-Directed Learning Readiness Scale (SDLRS) serves as the primary dependent measure for this study. This validated 58-item instrument assesses participants' levels of self-directed learning across the key dimensions identified in the literature: goal-setting, self-monitoring, self-motivation, and self-reflection. The instrument has demonstrated strong internal consistency (Cronbach's  $\alpha = 0.87$  to  $0.91$ ) in previous studies with similar populations. Items are rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), providing a comprehensive assessment of participants' SDL capabilities and tendencies.

To measure participants' engagement with specific online learning platform features, a researcher-developed Platform Features Usage Questionnaire (PFUQ) is administered. This 30-item questionnaire includes subscales for interactive features (8 items, e.g., "I regularly use interactive simulations"), personalization features (7 items, e.g., "I follow recommended learning paths"), self-monitoring tools (8 items, e.g., "I check my progress analytics"), and social learning components (7 items, e.g., "I participate in discussion forums"). Each item is rated on a 5-point Likert scale from 1 (never) to 5 (very frequently), allowing for nuanced assessment of feature usage patterns. The PFUQ undergoes pilot testing with 30 students not included in the main study to establish reliability and validity before full implementation. Content validity is established through expert review by three educational technology specialists and two self-directed learning researchers, ensuring the instrument adequately captures the relevant platform features.

The Frequency of Platform Use Measure (FPUM) specifically assesses participants' platform usage patterns, which is particularly relevant to testing H3. This measure collects detailed information on average hours per week spent on the learning platform, distribution of use (e.g., single long session vs. multiple shorter sessions), consistency of use throughout the semester, and types of features used during typical sessions. By capturing these multidimensional aspects of usage frequency, the study examines more nuanced relationships between platform engagement and SDL development beyond simple time-on-task metrics.

Additionally, a Demographic and Background Information Questionnaire collects information on age, gender, academic discipline, year level, GPA, prior experience with online learning (number of previous online courses), technological self-efficacy, and learning preferences. These variables are used as control variables in the regression analyses, allowing the study to isolate the specific effects of platform features on SDL while accounting for individual differences that might influence learning behaviors and outcomes.

The research is conducted over one academic semester following a systematic procedure to ensure methodological rigor and data quality. Initially, the researcher obtains IRB approval and permission from the participating universities to conduct the study. All instruments are finalized, including pilot testing of the PFUQ to establish its psychometric properties and refine any problematic items. Participant recruitment proceeds through invitations to randomly selected students from the stratified sampling frame, with clear information about the study's purpose, procedures, and confidentiality protections.

Data collection occurs at three time points throughout the semester. The initial assessment in Week 2 establishes baseline measures by administering the demographic questionnaire, SDLRS, PFUQ, and FPUM via an online survey platform. This timing allows students to become familiar with their online learning platforms before reporting on their usage patterns. A mid-semester assessment in Week 8 collects PFUQ and FPUM data again to capture changes in platform usage patterns as students' progress through their courses. Finally, a comprehensive assessment in Week 16 reapplies all measures to identify changes in SDL levels and platform usage by the end of the semester.

To complement and validate self-reported usage data, learning management system analytics are collected throughout the semester with participant consent. These objective measures of platform engagement include frequency of logins, time spent on different platform features, and patterns of feature usage. This data triangulation approach strengthens the validity of the findings by addressing potential limitations of self-report measures alone, providing a more accurate picture of how students actually engage with their online learning environments.

RESULTS AND DISCUSSION

Descriptive statistics were computed to assess participants' self-directed learning (SDL) levels and their usage of various online platform features. As shown in Table 1, the mean SDL readiness score was 3.82 (SD = 0.54), indicating a generally moderate-to-high level of self-direction among participants. Among the platform features, interactive tools and self-monitoring tools had the highest reported usage (means of 4.2 and 4.1, respectively), while social learning features were the least frequently used (mean = 3.3), suggesting a preference for independent learning modes over peer-based collaboration.

Table 1. Descriptive Statistics of Key Variables.

Variable	Mean	SD	Min	Max
SDL Readiness (Overall)	3.82	0.54	2.6	4.9
Goal-setting	3.76	0.58	2.4	4.8
Self-monitoring	3.89	0.51	2.7	5.0
Self-reflection	3.81	0.55	2.5	4.9
Platform Use Frequency (hrs/week)	6.3	2.1	1.0	12.0
Interactive Feature Use	4.2	0.6	2.8	5.0
Personalized Content Use	3.8	0.7	2.1	5.0
Self-Monitoring Tools Use	4.1	0.5	3.0	5.0
Social Learning Feature Use	3.3	0.8	1.5	4.9

Source: Prepared by authors

Pearson correlation coefficients were calculated to examine associations between online learning platform features and dimensions of SDL. As shown in Table 2, interactive features, personalized content, and self-monitoring tools all demonstrated statistically significant positive correlations with SDL readiness and its subcomponents. Notably, the use of



self-monitoring tools had the strongest correlation with self-monitoring skills ( $r = 0.53, p < .01$ ). Social learning features showed weak and nonsignificant associations across all SDL dimensions.

Table 2: Correlation Matrix between Platform Features and SDL Dimensions.

	Goal-setting	Self-monitoring	Self-reflection	SDL Readiness
Interactive Features	0.42**	0.38**	0.36**	0.44**
Personalized Content	0.47**	0.29*	0.31*	0.41**
Self-Monitoring Tools	0.33**	0.53**	0.48**	0.50**
Social Learning Features	0.19	0.22	0.17	0.20
Platform Use Frequency	0.38**	0.49**	0.46**	0.51**

(\* $p < .05$ , \*\* $p < .01$ )

Source: Prepared by authors

To test the proposed hypotheses, a multiple regression analysis was conducted with SDL readiness as the dependent variable. As shown in Table 3, all three predictors—interactive features, personalized content, and platform use frequency—had statistically significant positive effects on SDL readiness. Platform use frequency emerged as the strongest predictor ( $\beta = .41, p < .001$ ), supporting H3. These results confirm that regular, intentional engagement with platform features fosters deeper levels of self-regulation and autonomous learning.

Table 3: Multiple Regression Results Predicting SDL Readiness-

Predictor	B	SE	$\beta$	t	p
Interactive Features	0.28	0.09	0.32	3.11	0.002
Personalized Content	0.21	0.10	0.27	2.15	0.034
Platform Use Frequency	0.34	0.08	0.41	4.25	< 0.001
Constant	1.67	0.35	—	4.77	< 0.001

Source: Prepared by authors

Further analysis revealed meaningful differences across learner subgroups. As shown in Table 4, postgraduate students demonstrated significantly higher SDL readiness scores compared to undergraduates ( $t = 3.26, p = 0.001$ ). Similarly, students who reported high platform usage ( $\geq 5$  hours/week) scored significantly higher in SDL readiness than those with lower usage levels ( $t = 4.21, p < 0.001$ ). These findings highlight the moderating effect of learner experience and engagement frequency on SDL development.

Table 4: SDL Readiness by Learner Type.

Group	N	Mean SDL	SD	t	p
Undergraduates	90	3.71	0.48	-3.26	0.001
Postgraduates	74	3.97	0.52	3.26	0.001
Low Platform Usage (<5h/week)	62	3.55	0.51	-4.21	<0.001
High Platform Usage ( $\geq 5$ h/week)	102	3.98	0.49	4.21	<0.001

Source: Prepared by authors

These findings support the theoretical assumptions of SDL development through technological affordances. Consistent with (Garrison, 1997; Zimmerman, 2015), the study confirms that tools enabling self-monitoring, goal-setting, and feedback are essential to fostering SDL. The particularly strong impact of platform use frequency underscores the role of habitual engagement in forming metacognitive routines, echoing findings by Vandoni et al. (2024). Interestingly, the relatively weak impact of social learning features suggests that peer-based tools may not universally support self-direction. As noted by Al-Adwan et al. (2024), cultural orientation and individual learner preferences may mediate how learners perceive and use collaborative features.

For educators, the findings suggest the value of embedding regular prompts for reflection and structured goal-setting into course design. For platform developers, attention should be paid to the design of adaptive pathways and progress visualization tools, which were shown to significantly enhance learner autonomy. Motivation, prior digital learning experience, and the quality of instructional design emerged as important contextual factors that shaped outcomes, indicating that platform effectiveness is not solely a matter of technology but also pedagogy and implementation context.

## CONCLUSIONS

This study examined the role of online learning platforms in enhancing university students' self-directed learning (SDL) abilities, focusing on three key platform features: interactivity, personalized content, and usage frequency. The findings confirm that online learning environments—when thoughtfully designed and consistently used—can significantly support SDL development, especially in the dimensions of goal-setting, self-monitoring, and self-reflection.

Interactive tools were shown to promote learner autonomy by fostering engagement and decision-making. Personalized content helped students articulate clearer learning goals aligned with their individual progress. Most notably, frequent platform usage emerged as the strongest predictor of SDL readiness, suggesting that habitual engagement builds metacognitive routines essential for sustained self-direction. These findings validate and extend theoretical frameworks such as Zimmerman's model of self-regulation and Self-Determination Theory.

For educators, the results underscore the value of embedding reflective prompts, adaptive pathways, and structured self-assessment opportunities within digital course designs. Instructors should also consider student experience levels, as novice learners may require greater scaffolding to benefit fully from platform tools. For platform developers, the study highlights the importance of intuitive, feedback-rich environments that promote learner agency. Features like progress dashboards, adaptive recommendations, and frequent low-stakes assessments can meaningfully support metacognitive engagement.

This research relied partly on self-reported data, which may be subject to bias despite triangulation with usage analytics. Additionally, the generalizability of findings may be limited by the specific platforms and university settings studied. The relatively short observation period (one academic semester) may also not fully capture long-term SDL development.

Future studies could adopt longitudinal or experimental designs to assess causal relationships between platform features and SDL over extended periods. Cross-platform and cross-cultural comparisons may offer further insights into how design principles and learner preferences interact in diverse educational contexts. Incorporating qualitative methods could also deepen understanding of students' subjective experiences and challenges in navigating self-directed learning online.

## REFERENCES

- Abouelenein, Y. A. M., Selim, S. A. S., & Aldosemani, T. I. (2025). Impact of an adaptive environment based on learning analytics on pre-service science teacher behavior and self-regulation. *Smart Learning Environments*, 12(1). <https://doi.org/10.1186/s40561-024-00340-7>
- Acosta-Servín, S., Veytia-Bucheli, M. G., & Cáceres-Mesa, M. L. (2025). *Innovar en la práctica docente. Desarrollo de competencias digitales en la Licenciatura*. Sophia Editions.
- Al-Adwan, A. S., Meet, R. K., Kala, D., Smedley, J., Urbaníková, M., & Al-Rahmi, W. M. (2024). Closing the divide: Exploring higher education teachers' perspectives on educational technology. *Information Development*. <https://doi.org/10.1177/02666669241279181>
- Du, J. & Hew, K. F. T. (2021). Using recommender systems to promote self-regulated learning in online education settings: current knowledge gaps and suggestions for future research. *Journal of Research on Technology in Education*, 54(4), 557–580. <https://doi.org/10.1080/15391523.2021.1897905>
- Garrison, D. R. (1997). Self-directed learning: Toward a comprehensive model. *Adult Education Quarterly*, 48(1), 18–33. <https://psycnet.apa.org/record/1998-00433-002>
- Huang, L., Zheng, J., Lajoie, S. P., Chen, Y., Hmelo-Silver, C. E., & Wang, M. (2024). Examining university teachers' self-regulation in using a learning analytics dashboard for online collaboration. *Education and Information Technologies*, 29(7), 8523–8547. <https://eric.ed.gov/?q=dashboard&pg=6&id=EJ1424327>
- Khan, S., Dimache, A., Gorman, D., & Gachon, C. (2024). Lean in Higher Educational Institutes: A Literature Review. *Studies in Educational Management*, 15, 1–19. <https://doi.org/10.32038/sem.2024.15.01>
- Knowles, M. S. (1975). *Self-directed learning: A guide for learners and teachers*. Association Press.
- Lee, D., Watson, S. L., & Watson, W. R. (2020). The influence of successful MOOC learners' self-regulated learning strategies, self-efficacy, and task value on their perceived effectiveness. *International Review of Research in Open and Distributed Learning*, 21(3), 81–98. <https://eric.ed.gov/?id=EJ1267156>

- Liu, Y. & Liu, Y. (2025). Advancing STEM Education for Sustainability: The Impact of Graphical Knowledge Visualization and User Experience on Continuance Intention in Mixed-Reality Environments. *Sustainability*, 17(9). <https://doi.org/10.3390/su17093869>
- Martinez-Lopez, R., Yot, C., Tuovila, I., & Perera-Rodriguez, V. H. (2017). Online self-regulated learning questionnaire in a Russian MOOC. *Computers in Human Behavior*, 75(6), 966-974. <https://linkinghub.elsevier.com/retrieve/pii/S0747563217303862>
- Mckinney, D. T. (2023). *Community College Students' Perceptions of Online Public Speaking Courses*. The University of Alabama.
- Schunk, D. H. & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, 60. <https://doi.org/10.1016/j.cedpsych.2019.101832>
- Shahzad, M. & Nadeem, M. A. (2021). Developing Learning Environment Using Interactive Multimedia. *Pakistan Journal Of Distance And Online Learning*, 7(1), 93-106. <https://files.eric.ed.gov/fulltext/EJ1321263.pdf>
- Sharma, V., Kumar, N., & Nardi, B. (2023). Post-growth human-computer interaction. *ACM Transactions on Computer-Human Interaction*, 31(1), 1-37. <https://dl.acm.org/doi/10.1145/3624981>
- Song, L. & Hill, J. R. (2007). A conceptual model for understanding self-directed learning in online environments. *Journal of Interactive Online Learning*, 6(1), 27-42. <https://eric.ed.gov/?id=EJ1092260>
- Swanzen, R. & Botha, C. (2023). The role of emotional intelligence within the entrepreneurial intention of graduate students: Informing curriculum in private higher education. (Paper). 15th International Conference on Education and New Learning Technologies. Palma, Spain.
- Tough, A. (1971). *The adult's learning projects: A fresh approach to theory and practice in adult learning* (2nd ed.). Learning Concepts.
- Vandoni, M., Marin, L., Cavallo, C., Gatti, A., Grazi, R., Albanese, I., ... & Calcaterra, V. (2024). Poor motor competence affects functional capacities and health-care in children and adolescents with obesity. *Sports*, 12(2). <https://pubmed.ncbi.nlm.nih.gov/38393264/>
- Zimmerman, B. J. (2015). Self-regulated learning: Theories, measures, and outcomes. In, J. D. Wright (Ed.), *International encyclopedia of the social & behavioral sciences*. (pp. 541-546). Elsevier.