INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 13, Issue 4, (2024) E-ISSN: 2226-6348

Exploring Learning Theory Usage in Web-Based Learning: A Comprehensive Literature Review

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To Link this Article: http://dx.doi.org/10.6007/IJARPED/v13-i4/23792 DOI:10.6007/IJARPED/v13-i4/23792

Published Online: 28 November 2024

Abstract

Web-based learning has become a modern education driven by technological advances and the need for a flexible learning environment. This study explores the use of learning theory in web-based learning and provides valuable insights to optimize educational outcomes and increase student engagement. A systematic search of scholarly articles from Scopus and Google Scholar from 2020 to 2024 was conducted. This study focuses on peer-reviewed articles that apply cognitive load theory, cognitive multimedia learning theory, social cognitive theory, behavioral theory, constructivist theory and connectivism theory to online learning contexts. The results show key applications of social cognitive theory and constructivist learning theory, underscoring their important role in enhancing interactivity and personalized learning experiences in digital settings. Cognitive load theory and cognitive multimedia learning theory, although less prevalent, are important to optimize educational content to align with cognitive capacity. The study highlights that the integration of this theory can profoundly improve the design and functionality of online learning systems. Recommendations suggest that educational technologists incorporate these insights to

develop adaptive, engaging, and effective web-based learning experiences that are responsive to the needs of diverse student populations.

Keywords: Web-Based Learning, E-Learning, Online Learning, Cognitive Theory, Constructivist Learning Theory

Introduction

Nowadays, the development of information technology in education focuses on digital learning. Web-based learning is a digital learning platform that can increase student productivity as it has elements of flexibility that can be implemented without limitations (Ahmad & Ali, 2022). It is a dynamic field that has evolved with technological advances and pedagogical research (Alkamel et al., 2018; MacDonald et al., 2001; Roberts, 2020). Its adaptability makes it a valuable tool for addressing educational challenges and opportunities in the digital age. Web-based learning, also known as online learning or e-learning. That is an educational approach that uses the Internet and digital technology to deliver educational content and facilitate the learning experience (Fauzi et al., 2018; Hoq, 2020; Zehry et al., 2011). It allows students to access educational materials, resources, and activities through web-based platforms (Tangirov et al., 2021). Web-based learning is important strategy in applied science and technology education, emphasizing collaborative and interactive technologies to advanced educational practices compared to conventional learning methods (Ahmad et al., 2025).

Conventional or traditional learning methods are usually focused on physical classrooms and direct face-to-face interaction. It provides immediate engagement and fosters real-time discussions and group activities (Hanbay, 2013). However, web-based learning transcends the geographical and temporal limitations associated with traditional methods. This enables students to choose both the timing and location of their study sessions, offering a significant flexibility advantage (Juang et al., 2010; Puspitasari et al., 2018). Research by Sang et al. (2018) and Konstantinidis et al. (2022) has demonstrated that online learning can be as effective, if not more so, than traditional educational methods, particularly in continuous professional fields such as healthcare. Figure 1 illustrates the use of e-learning in education.

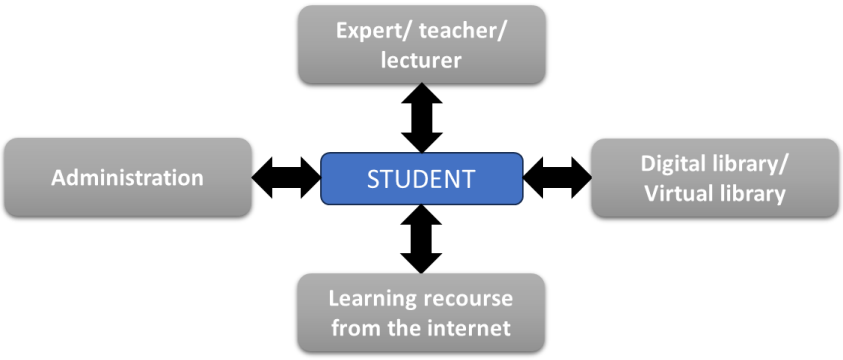

Figure 1. Demonstration of the use of e-learning in education (Puspitasari et al., 2018)

Figure 1 illustrates that e-learning utilizes computer technology to provide self-learning materials stored on a server that are accessible to all those involved in learning. E-learning incorporates schedules, curricula, learning progress, and administrative aspects within a computerized framework. It fosters interactions among students, with course content, and between students and instructors or peers. This enables sharing of information and opinions

related to learning and developmental needs, whereas experts/instructors can conveniently place learning materials and assignments online for student access (Puspitasari et al., 2018).

The success of web-based learning is influenced by the pedagogical model that supports its design and implementation. This model is based on several key learning theories that inform the structuring of online environments to optimize educational outcomes. For example, cognitive theory is related to students' understanding of internal mental processes (Alahmad, 2020). Constructivism theory related to students builds knowledge through experience and reflection (Matriano, 2020). Connectivism Theory is relevant in the digital era and supports the role of social technology in the learning process (Mampota et al., 2023).

Methodology

The methodology of this literature review involved articles published between 2020 and 2024 (5 years). The Scopus and Google Scholar databases were used. To ensure a focus on the literature, searches were limited to research articles. Conference papers, book chapters, and review articles were excluded. The keyword search used is "web-based learning" and synonyms of web-based learning are "e-learning", "learning management system" and "flipped classroom" to identify the article related to studies in web-based learning.

Result and Finding

Exploration of learning theories in web-based learning is comprehensive and diverse (Emadi, 2023). This study outlines the theoretical foundations of web-based learning and its impact on learning dynamics. A detailed comprehensive review of the use of learning theories in web-based learning is presented in Table 1.

Table 2
Comprehensive Review of Learning Theory Used in Web-Based Learning

ID	Author (Year)	Cognitive Theory			Behavioral Theory	Constructivist theory	Connectivism theory
		Cognitive Load Theory	Cognitive Multimedia Learning Theory	Cognitive Social Theory			
A1	Petillion & McNeil (2020)	/		/			
A2	Kuo et al. (2021)			/			
A3	Panigrahi et al. (2021)			/			
A4	Burcă-Voicu et al. (2022)			/			
A5	Li (2022)					/	
A6	Ranga (2022)	/	/				
A7	Stetten et al. (2022)					/	
A8	Aldhafeeri & Alotaibi (2023)	/				/	/
A9	Gutierrez et al. (2023)	/					
A10	Gupta & Bamel (2023)			/			
A11	Rankapola & Zuva (2023)			/			

ID	Author (Year)	Cognitive Theory			Behavioral Theory	Constructivist theory	Connectivism theory
		Cognitive Load Theory	Cognitive Multimedia Learning Theory	Social Cognitive Theory			
A12	Nelligan et al. (2023)				/		
A13	Howell et al. (2023)			/			
A14	Kamarudin et al. (2023)			/			
A15	Motl et al. (2023)			/			
A16	Rogers et al. (2023)			/			
A17	Sayaf (2023)					/	
A18	Supitayakul et al. (2023)		/				
A19	Ambe et al. (2024)					/	
A20	Chou et al. (2024)			/			
A21	Naz & Robertson (2024)			/			
A22	Sevnarayan & Maphoto (2024)			/			
A23	Skrupky et al. (2024)		/				
A24	Zhenchenko et al. (2024)					/	

Table 1 highlights various learning theories in web-based learning as derived from the analysis. This analysis reveals that social cognitive theory is the predominant, utilized in 54% of the studies. This theory is crucial for understanding how social interactions and observational learning enhance online educational experiences, making it highly relevant in the digital learning landscape. Following this, constructivist theory is 25% of the research articles. This theory centers on students building knowledge through personal experiences and reflection. It is also particularly suited to the interactive and often autonomous nature of web-based learning. Cognitive load theory, featured in 17% of the articles. That focuses on optimizing the mental effort required during learning. Its application is vital for designing digital educational materials that effectively manage the cognitive demands on students to ensure more efficient learning processes. Cognitive multimedia learning theory is 13% of the studies and highlights the importance of effectively designed multimedia content that aids in learning by catering to various cognitive processes. Lastly, both connectivism and behavioral theory are less prevalent, only 4% of the articles each. Connectivism theory is significance of networks and connections in learning, while behavioral theory focuses on observable behaviors, which seems to be less emphasized in current web-based learning research.

Discussion

Theoretical approaches have been used to improve web-based learning and reflect the complexity and dynamics of educational research in the digital age (O'Neil & Perez 2013). Each theory has unique insights that can significantly enrich the design of integrated online learning platforms (Ellis & Bliuc, 2019). 54% of previous studies use social cognitive theory, which focuses on the interaction between cognitive, behavioral, and environmental factors in learning (Bandura, 1986). In web-based learning, this theory helps online learning

environments where the students learn not only from the content but also by observing the actions. It creates a sense of community in online platforms by encouraging peer engagement, as seen in platforms incorporating video-based learning with live instructor interaction (Petillion & McNeil, 2020). This social interaction, coupled with observational learning, makes it particularly effective in environments where peer engagement and instructor guidance are key, such as collaborative e-learning systems (Burcă-Voicu et al., 2022; Kuo et al., 2021).

Constructivist theory, found in 25% of the previous research, emphasizes student-centered learning, where students construct knowledge through personal experiences and reflections (Piaget, 1970). In web-based learning, this theory supports the development of online courses that encourage active learning and problem-solving. The theory also suggests that students benefit from interactive digital platforms. It also adapts to their personal learning paths, promoting a deeper engagement with the material. For example, constructivist approaches were particularly useful in facilitating collaborative learning projects and online forums. Students can exchange ideas and build knowledge together (Aldhafeeri & Alotaibi, 2023; Li, 2022). This interaction is grounded in real-life contexts and supports cognitive development, making the theory essential for developing flexible and adaptive learning systems.

Cognitive load theory is applied in 17% of the previous studies. It focuses on managing the mental effort required for learning. Developed by Sweller (1988), this theory categorizes cognitive load into intrinsic, extraneous, and germane. Each of which must be optimized to prevent cognitive overload in students. In web-based learning, the theory is crucial for designing educational content that ensures students are not overwhelmed by information. For example, structuring content with clear, segmented modules, as seen in video-based and HyFlex classroom setups. It allows students to process information at their own pace (Ranga, 2022). This approach is particularly important when dealing with complex topics on e-learning platforms. That is ensuring that learning remains efficient and effective.

Cognitive multimedia learning theory, utilized in 13% of the previous studies. It extends cognitive theory into the domain of multimedia by providing a framework for the integration of text, images, and audio to improve learning. This theory, proposed by Mayer (2002), is especially relevant in digital education, where multimedia content is prevalent. It emphasizes that students process information better when it is presented through both visual and auditory channels, as long as the content is well-structured and not overwhelming. Research by Supitayakul et al. (2023) supports this by demonstrating how combining visual and auditory stimuli can enhance memory retention in online learning. Although the percentage of cognitive multimedia learning theory is 13%, it is very important because this theory is fundamental in the design of e-learning modules that aim to improve engagement by utilizing multimedia in an optimal way. Figure 2 shows the cognitive theory of multimedia learning through a series of boxes and arrows.

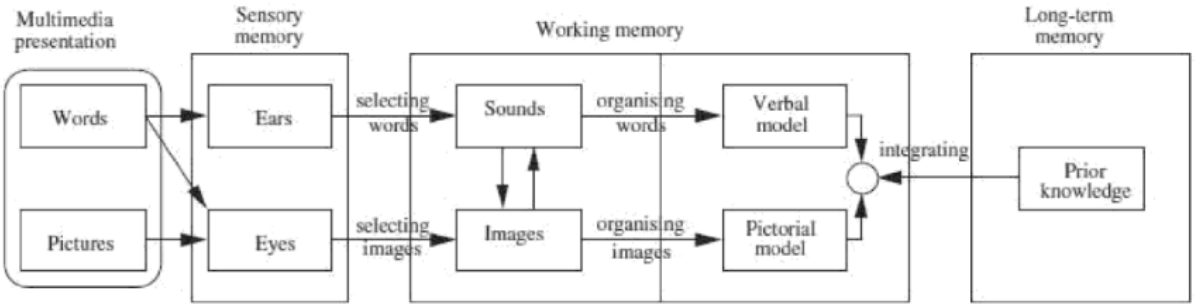

Figure 2. A cognitive theory of multimedia learning (Adapted from Mayer 2001) (Mayer, 2002)

Behavioral theory, although used only in 4% of the previous studies. It remains relevant for scenarios where specific behaviors need to be reinforced, such as in language learning or technical skill acquisition. Rooted in Skinner's work on operant conditioning, behavioral theory emphasizes the role of reinforcement in shaping learning outcomes (Skinner, 1965). In web-based learning platforms, this theory is applied through mechanisms like instant feedback, quizzes, and digital badges, all of which serve to reinforce positive learning behaviors (Nelligan et al., 2023). While not as prevalent as cognitive or social theories, it proves useful in certain educational contexts that require measurable behavioral outcomes.

Lastly, connectivism theory, also applied in 4% of the previous studies, emphasizes the role of networks in learning. Proposed by Siemens (2005), connectivism is particularly suited to the digital age, where students navigate vast networks of information. This theory highlights the importance of digital learning and the ability to make connections between various sources of knowledge. In web-based learning environments, connectivism promotes the integration of social media and other networking tools to facilitate knowledge-sharing among students (Aldhafeeri & Alotaibi, 2023). By creating dynamic and interactive communities, this theory supports continuous learning and adaptation to the digital landscape.

Conclusion

The exploration of theoretical frameworks in web-based learning highlights the complex interactions between educational methods and digital technologies. Social cognitive theory is the most utilized and demonstrates its strong ability to create community and collaboration online. It can create platforms where learning is as much about interaction as it is about content consumption. Constructivist theory’s emphasis on active, student-centered learning is critical for developing systems that not only deliver content but also engage students in meaningful knowledge production. Cognitive load theory’s strategic focus on optimizing cognitive processing ensures that digital content is designed in a way that prevents overload. It can enhance the student’s ability to understand and retain information. This is important in an era where digital content is common, and the risk of cognitive overload is high. Cognitive multimedia learning theory further complements this by providing a structured approach to multimedia learning, where dual coding and careful integration of text, audio, and visuals play significant roles in enhancing comprehension and retention. Even less commonly applied theories like behavioral and connectivism theory still offer significant insights and tools for specific educational needs. Behavioral theory’s principles of reinforcement and feedback are critical in settings where behavioral change or skill development is the goal. It suggests that even traditional theories have a place in modern digital learning. Meanwhile, connectivism’s focus on the power of networks and digital connectivity highlights the increasingly interlinked

nature of knowledge and learning in the digital age. It supports educational systems that use these connections to promote deeper learning and comprehension. Referring to the trend of theories used in this literature, it was found that all theories are important, but it's depending on the needs and objectives of the research. These theories inform the development of dynamic and responsive educational platforms capable of meeting the different demands of today's students. They not only highlight the need for theoretical diversity in addressing the complexities of digital education but also showcase the potential for these theories to evolve and intersect. It is creating innovative educational practices that are crucial for the digital learning landscapes of the future.

Acknowledgements

This research was supported and funded by the Jabatan Perkhidmatan Awam Malaysia (JPA) through the Hadiah Latihan Persekutuan (HLP) scholarship.

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Appendix A

List of articles for this related to this research

ID	Author (Year)	Title
A1	Petillion & McNeil (2020)	Johnstone's Triangle as A Pedagogical Framework for Flipped-Class Instructional Videos in Introductory Chemistry
A2	Kuo et al. (2021)	Linking Web-Based Learning Self-Efficacy and Learning Engagement in MOOCs: The Role of Online Academic Hardiness
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