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Exploring the Levels of eLearning Interactivity: A Review of Research Literature

Alajab Mohammed Alajab Ismail[1]

Abstract

eLearning has become a widespread and integral part of modern education and training. A key aspect of effective eLearning is interactivity, which can enhance engagement, learning, and knowledge retention. This paper provides a comprehensive review of the research literature on the levels of interactivity in eLearning environments. The review examines different taxonomies and frameworks proposed to categorize and assess the various levels of interactivity, from low-level interactions such as clicking and scrolling, to more advanced interactive features like simulations, virtual reality, and collaborative learning tools. The paper also discusses the pedagogical benefits of increasing interactivity, as well as the design and implementation considerations for achieving optimal levels of interactivity in eLearning. Finally, the review identifies gaps in the current research and suggests future directions for studying the impact of interactivity on eLearning outcomes.

Keywords: *Elearning, Interactivity, Levels of Interactivity, Taxonomies and Frameworks, Pedagogical Benefits, Design and Implementation Considerations, And Impact on Elearning Outcomes.*

Introduction

eLearning has emerged as a popular mode of education in recent years, driven by technological advancements. eLearning provides learners with the flexibility to learn at their own pace and convenience and is often more cost-effective than traditional classroom-based learning. However, the effectiveness of eLearning is dependent on several factors, including interactivity. Interactivity in eLearning is defined as the "dialogue" between learners and eLearning tools, which allows learners to become actively involved in the learning process. This can include various forms of interaction such as quizzes, simulations, and multimedia elements that encourage learners to experiment and learn from their mistakes (Christopher, 2015). It refers to the degree to which learners can engage with the content and the presented activities. eLearning interactivity has been found to enhance learners' motivation, engagement, and learning outcomes

The rapid growth of online and technology-enabled learning, commonly known as eLearning, has transformed the landscape of modern education and training (Allen & Seaman, 2017). A key aspect distinguishing eLearning from traditional in-person instruction is the level of interactivity afforded to learners (Mayer, 2014). Interactivity in eLearning environments can enhance learner engagement, improve knowledge retention, and foster a deeper understanding of the subject matter (Ke, 2016; Tamin et al., 2011).

This growth of digital technologies has transformed the landscape of education and training, giving rise to the widespread adoption of eLearning. eLearning, the delivery of instructional content and activities through electronic devices and the internet, offers numerous advantages over traditional classroom-based learning, such as increased accessibility, flexibility, and personalization (Sams & Bergmann, 2013). However, a key factor that determines the effectiveness of eLearning is the level of interactivity it provides.

Interactivity in eLearning refers to the active engagement and participation of learners with the instructional content, tools, and other learners (Schreurs & Dumbraveanu, 2014). Interactivity can take various forms, from simple interactions like clicking and scrolling to more advanced features like simulations, virtual reality, and collaborative learning activities. The degree of interactivity in an eLearning environment can have a significant impact on learners' motivation, engagement, and learning outcomes (Kalyuga, 2007).

[1] Department of Curriculum & Instruction, Arabian Gulf University (Kingdom of Bahrain), Email: alagabm@agu.edu.bh.

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In recent years, university teaching methods have evolved and almost all higher education institutions use e-learning platforms to deliver courses and learning activities. Khaldi, Bouzidi, and Nader (2023) reported on a study focused on providing a comprehensive overview of the current state of gamification in online learning in higher education that can serve as a resource for gamification practitioners when designing gamified systems. They aimed to systematically explore the different game elements and gamification theory that have been used in empirical studies; establish different ways in which these game elements have been combined and provide a review of the state-of-the-art approaches proposed in the literature for gamifying e-learning systems in higher education. A systematic search of databases was conducted to select articles related to gamification in digital higher education for this review, namely, Scopus and Google Scholar databases. The study found that PBL elements (points, badges, and leaderboards), levels, and feedback are the most commonly used elements for gamifying e-learning systems in higher education. They also observed the increasing use of deeper elements like challenges and storytelling. The authors' classification of gamification approaches revealed the trend toward customization and personalization in gamification and highlighted the lack of studies on content gamification compared to structural gamification.

Researchers have proposed various taxonomies and frameworks to categorize the different levels of interactivity in eLearning (Chou, 2003; Huang et al., 2019). These range from low-level interactions, such as clicking and scrolling, to more advanced interactive features, including simulations, virtual reality (VR) experiences, and collaborative learning tools (Dede, 1995; Hew & Cheung, 2010). Understanding the impact of these varying levels of interactivity on learning outcomes is crucial for the effective design and implementation of eLearning systems (Boštjančič & Jerman, 2018; Wanless, 2016).

This paper provides a comprehensive review of the research literature on the levels of interactivity in eLearning environments. The review examines different taxonomies and frameworks proposed for categorizing interactivity, the pedagogical benefits of increasing interactivity, and the design and implementation considerations for achieving optimal levels of interactivity in eLearning. Finally, the review identifies gaps in the current research and suggests future directions for studying the impact of interactivity on eLearning outcomes.

Problem Statement

While the benefits of increased interactivity in eLearning environments are well-documented, the research literature has not yet provided a comprehensive understanding of the different levels of interactivity and their impact on learning outcomes. Existing taxonomies and frameworks for categorizing interactivity often focus on specific interactive features or modalities, without offering a holistic view of the full spectrum of interactivity (Chou, 2003; Huang et al., 2010). Additionally, the design and implementation considerations for achieving optimal levels of interactivity in eLearning are not well-established, leading to inconsistent and suboptimal interactivity in many eLearning systems (Boštjančič & Jerman, 2018; Wanless, 2016). This lack of a cohesive understanding of interactivity in eLearning environments presents a significant challenge for educators, instructional designers, and technology developers who aim to leverage the full potential of interactivity to enhance learning and engagement. Addressing this gap in the research literature is crucial for the continued evolution and improvement of eLearning experiences.

Aim and Objectives of the Study

The primary aim of this research is to provide a comprehensive review of the literature on the levels of interactivity in eLearning environments and their impact on learning outcomes.

To achieve this aim, the study has the following key objectives:

- To examine different taxonomies and frameworks proposed for categorizing the various levels of interactivity in eLearning, ranging from low-level interactions to more advanced interactive features.

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- To investigate the pedagogical benefits of increasing interactivity in eLearning, including its impact on learner engagement, knowledge retention, and deeper understanding of the subject matter.

- To identify the design and implementation considerations for achieving optimal levels of interactivity in eLearning, addressing factors such as instructional design, technology integration, and learner preferences.

- To critically analyze the current research landscape and identify gaps or limitations in the existing literature, to inform future research directions in interactive eLearning.

By addressing these objectives, the study aims to contribute to a more holistic understanding of interactivity in eLearning and provide insights that can inform the development of more effective and engaging eLearning experiences.

Objectives of the Study

Main Objective: To provide a comprehensive review of the research literature on the levels of interactivity in eLearning environments and their impact on learning outcomes.

Sub-Objectives

Examine taxonomies and frameworks for categorizing interactivity in eLearning

- Identify and analyze different taxonomies proposed in the literature
- Assess the scope and limitations of these taxonomies
- Explore the evolution and refinement of interactivity frameworks over time

Investigate the pedagogical benefits of increasing interactivity in eLearning

- Analyze the impact of interactivity on learner engagement and motivation
- Examine the relationship between interactivity and knowledge retention
- Explore how interactivity can foster deeper understanding and critical thinking

Identify design and implementation considerations for optimal interactivity

- Explore instructional design principles for integrating interactive elements
- Analyze the role of technology and emerging interactive features
- Investigate learner preferences and their influence on interactivity design

Critically analyze gaps and limitations in the current research

- Identify areas where the literature is lacking or inconsistent
- Recognize opportunities for further research and exploration
- Propose future directions for studying the impact of interactivity on eLearning

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By addressing these sub-objectives, the study aims to provide a comprehensive understanding of the current state of research on interactivity in eLearning and offer insights that can inform the development of more effective and engaging eLearning experiences.

Significance of the Study

This comprehensive review of the research on interactivity in eLearning environments is valuable for several key stakeholders. For educators and instructional designers, the study will provide a deeper understanding of the different levels of interactivity and their pedagogical benefits, enabling them to make more informed decisions when designing and implementing eLearning programs. By identifying the design and implementation considerations for optimal interactivity, the study will offer practical guidance to help ensure that eLearning experiences are engaging, effective, and tailored to learner needs.

For technology developers and eLearning platform providers, the study will offer insights into the evolving landscape of interactive features and their impact on learning outcomes. This knowledge can inform the development of more innovative and impactful eLearning tools and technologies, ultimately enhancing the overall quality and effectiveness of online and technology-enabled learning.

Moreover, the study will contribute to the wider academic discussion on the role of interactivity in education and training. By critically examining the current research landscape and identifying gaps, the study will highlight areas for future exploration, inform the research agenda, and promote the continued advancement of interactive eLearning. The findings and recommendations from this review can serve as a valuable resource for researchers, policymakers, and educational leaders as they work to harness the full potential of interactivity to improve learning experiences and outcomes.

Definitions of Key Terms

Here are definitions of key terms used in the study:

Interactivity: Interactivity refers to the degree of mutual action and reaction between a learner and an eLearning environment, enabling learners to interact with and dynamically manipulate the learning content (Chou, 2003; Huang et al., 2010).

eLearning: eLearning, or electronic learning is the provision of educational or training content through digital technologies, such as computers, tablets, or smartphones, often facilitated by the internet or other network-based media (Allen & Seaman, 2017).

Learner Engagement: Learner engagement is the level of attention, interest, curiosity, and motivation exhibited by learners during the learning process, which can be influenced by the degree of interactivity in an eLearning environment (Mayer, 2014; Wanless, 2016).

*Knowledge Retention***:** Knowledge retention refers to the ability of learners to recall and apply the information and skills they have acquired through the learning experience, which can be improved through interactive components in eLearning (Tamin et al., 2011).

*Deeper Understanding***:** Deeper understanding goes beyond simple memorization of facts and involves the ability to analyze, synthesize, and critically apply the acquired knowledge, which can be facilitated by interactive eLearning experiences (Ke, 2016).

Instructional Design: Instructional design is the systematic process of designing, developing, and implementing effective learning experiences, considering various factors such as learner needs, learning objectives, and integrating of appropriate interactive elements (Boštjančič & Jerman, 2018).

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Literature Review

The rapid advancements in digital technologies and the widespread adoption of eLearning have transformed the landscape of education and training. A crucial aspect of these evolving eLearning environments is the concept of interactivity, which has been the focus of extensive research in recent decades. Interactivity, defined as the mutual action and reaction between a learner and the learning content or system, has emerged as a key factor in enhancing the effectiveness and engagement of eLearning experiences (Chou, 2003; Huang et al., 2010).

Since about 2010 e-learning has been embedded in educational practice and has become, surely due to the COVID-19 pandemic, increasingly important, although much has been written about e-learning, little is known about crucial didactic and pedagogical design principles for e-learning. Theelen and van Breukelen (2022) systematically reviewed 42 studies (out of 1857 unique hits) that addressed e-learning design in higher education. Open and axial coding was used for analysis. Results indicated that; there were two continuums distinguished as important for e-learning: (1) the active learning continuum and (2) the authentic learning continuum. Those continuums appeared to be useful in giving a visual representation of included studies through an active and authentic learning continuum. This resulted in four clusters with (slightly) different properties. These properties vary from a relatively low to a high level of authenticity, and from teacher to student-centered. Analysis also revealed four crucial aspects of e-learning design: (1) content scaffolding, (2) process scaffolding, (3) peer-to-peer learning, and (4) formative strategies. Most elearning approaches demand an educational design that facilitates authentic learning and self-regulation.

As eLearning plays an increasingly prominent role in education and professional development, understanding the different levels of interactivity and their impact on learning outcomes has become a critical area of inquiry. Researchers have proposed various taxonomies and frameworks to categorize the diverse interactive features and functionalities available in eLearning environments, ranging from low-level interactions to more advanced, immersive experiences (Dix, 2009; Liu & Chu, 2010). These taxonomies provide a systematic way to analyze how learners can engage with and manipulate the learning content, ultimately shaping their overall learning experience.

In parallel, a growing body of research has investigated the pedagogical benefits of incorporating higher levels of interactivity into eLearning, exploring its impact on learner engagement, knowledge retention, and the development of deeper understanding (Mayer, 2014; Tamin et al., 2011). As educators and instructional designers strive to create more effective and engaging eLearning experiences, it is crucial to examine the design and implementation considerations for achieving optimal levels of interactivity that cater to diverse learner needs and preferences.

This comprehensive literature review aims to synthesize the current research on interactivity in eLearning, analyzing the various taxonomies and frameworks, the pedagogical implications, and the design considerations for implementing effective interactive features. By identifying the gaps and limitations in the existing literature, the review will also highlight opportunities for future research that can further advance the understanding and application of interactivity in eLearning.

Taxonomies and Frameworks for Interactivity in eLearning

The research literature has proposed several taxonomies and frameworks to conceptualize the different levels of interactivity present in eLearning environments. These taxonomies provide a structured way to categorize and analyze the diverse interactive features and functionalities available to learners.

Pedagogical agents (PAs) are a crucial aspect of the e-learning environment. A PA is defined as a virtual character presented on an interface, and they are designed to promote student learning. PAs have been widely discussed in academic papers. However, an appropriate analysis framework has not been proposed because of the diversity and complexity of PAs. Peng and Wang (2022) reviewed the literature and proposed a list of related clues, including environmental, learner, role, appearance, and social clues. They used this framework to analyze the learning effectiveness of PAs in specific areas. The keyword 'pedagogical agent'

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was used to search for related papers from 2000 to 2019. A total of 136 papers were obtained. A meta-analysis was performed using a random effects model (Hedges' g was used to measure the effect size). The effect size of the learning effectiveness of PA was small to medium (g = 0.423). The results of subgroup analysis (Hedges's g) revealed that subjects, grades, additional support, appearance style, and facial expression changes had a different moderating effect on the effect of PA on learning effectiveness.

One of the pioneering frameworks was developed by Chou (2003), who identified three primary levels of interactivity: reactive, proactive, and mutual. Reactive interactivity involves the learner responding to predetermined actions or choices, such as clicking on hyperlinks or selecting from multiple-choice options. Proactive interactivity allows learners to manipulate or control the learning content, for example, by adjusting the pace, sequence, or presentation of the material. Mutual interactivity, the highest level, enables learners to actively collaborate, communicate, and co-create content with instructors or fellow learners (Chou, 2003).

Building upon this foundational work, Huang et al. (2010) proposed a more comprehensive framework that categorizes interactivity into four dimensions: learner-content, learner-instructor, learner-learner, and learner-system. The learner-content dimension encompasses how learners interact with the learning materials, such as annotations, simulations, or exploratory activities. The learner-instructor dimension focuses on the interactions between learners and instructors, including feedback, guidance, and direct communication. The learner-learner dimension examines the collaborative and social interactions among learners, while the learner-system dimension considers the technical features and interface design that enable learners to navigate and control the eLearning environment (Huang et al., 2010).

More recently, Bower (2017) proposed a refined taxonomy that differentiates between three levels of interactivity: reactive, proactive, and generative. Reactive interactivity involves simple responses to predefined stimuli, such as selecting options or watching animations. Proactive interactivity allows learners to manipulate and control various aspects of the learning content or environment. Generative interactivity, at the highest level, empowers learners to create, generate, or produce new content, ideas, or solutions, demonstrating a deeper level of engagement and understanding (Bower, 2017).

These taxonomies and frameworks, along with their underlying principles and components, have been widely referenced and applied in the design, development, and evaluation of eLearning programs (Dix, 2009; Liu & Chu, 2010). By providing a structured approach to conceptualizing interactivity, these models have helped educators and instructional designers make more informed decisions about the integration of interactive features and the potential impact on learning outcomes.

The evolution of these taxonomies reflects the growing complexity and sophistication of interactive features in eLearning environments. Each framework has its strengths and limitations, and collectively they provide a nuanced understanding of the different levels and dimensions of interactivity. As eLearning continues to evolve, likely future taxonomies will further refine and expand upon these models, incorporating emerging technologies and pedagogical approaches to capture the full spectrum of interactive learning experiences.

Scope and Level of Detail in Interactivity Frameworks

The various taxonomies and frameworks proposed for conceptualizing interactivity in eLearning environments differ in their scope and the level of detail they provide.

Scope of the Frameworks

The scope of these frameworks can be broadly categorized as follows:

Chou's (2003) Framework: This framework has a relatively narrow scope, focusing primarily on the learner's role and the progression of interactivity levels from reactive to proactive to mutual.

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Chou's (2003) framework for interactivity in eLearning provides valuable insights into the learner's role and the progression of interactivity levels. The framework categorizes interactivity into three distinct levels:

Reactive Interactivity: At this level, learners respond to predefined prompts or stimuli from the eLearning environment. Interaction is limited, with learners primarily consuming content without significant engagement. This type of interactivity often includes activities like answering questions or clicking through slides.

Proactive Interactivity: Here, learners take a more active role in their learning process. They initiate actions, such as exploring resources or participating in discussions. This level encourages learners to think critically and engage with the content more deeply, promoting a sense of ownership over their learning.

Mutual Interactivity: The highest level of interactivity involves a collaborative learning environment where learners and the system (or their peers) interact dynamically. This can include group projects, peer feedback, and real-time discussions. At this stage, learners not only engage with the content but also with each other, facilitating a richer learning experience.

Chou's framework emphasizes the importance of understanding these levels of interactivity to design effective eLearning experiences that cater to the learner's evolving role. By progressing from reactive to mutual interactivity, educational designers can enhance engagement and improve learning outcomes.

Huang et al.'s (2010) Framework: This framework has a more comprehensive scope, encompassing four distinct dimensions of interactivity: learner-content, learner-instructor, learner-learner, and learner-system. By considering these multiple dimensions, the framework provides a holistic view of the interactive experiences within eLearning environments.

Huang et al.'s (2010) framework for interactivity in eLearning expands on existing models by providing a comprehensive approach that includes cognitive, behavioral, and social dimensions of interactivity. Here are the key components of their framework:

Cognitive Interactivity: This dimension focuses on the mental processes involved in learning. It emphasizes how learners interact with the content to construct knowledge and develop understanding. Activities that promote cognitive interactivity include problem-solving tasks, critical thinking exercises, and reflective practices, which encourage deeper engagement with the material.

Behavioral Interactivity: This aspect pertains to the observable actions of learners as they engage with the eLearning environment. It includes activities such as clicking on links, participating in discussions, and completing quizzes. Behavioral interactivity is crucial for measuring engagement and understanding how learners navigate through the content.

Social Interactivity: Huang et al. highlight the importance of social interactions among learners and between learners and instructors. This dimension includes collaborative activities, peer feedback, and discussions that foster a community of learning. Social interactivity enhances motivation and can lead to better learning outcomes by creating a supportive learning environment.

Integration of Dimensions: The framework emphasizes that these three dimensions are interconnected and should be integrated into the design of eLearning experiences. A well-rounded approach that incorporates cognitive, behavioral, and social interactivity can create a more engaging and effective learning environment.

Overall, Huang et al.'s framework provides a holistic view of interactivity in eLearning, highlighting the need for a balanced approach that addresses different aspects of learner engagement. By considering cognitive, behavioral, and social dimensions, educators can design more effective eLearning experiences that cater to diverse learner needs.

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Bower's (2017) Framework: This framework has a scope that is similar to Chou's (2003) model but with the addition of the "generative" level of interactivity. This expanded scope allows for the recognition of more advanced, learner-driven interactions that go beyond the manipulation of content or systems.

Bower's (2017) framework for interactivity in eLearning provides a structured approach to understanding how different types of interactivities can enhance the learning experience. Here are the key components of Bower's framework:

Types of Interactivities: Bower identifies several types of interactivities that can be incorporated into eLearning environments:

Learner-Content Interaction: This involves how learners engage with the material, such as reading texts, watching videos, or participating in simulations. Effective learner-content interaction promotes understanding and retention.

Learner-Instructor Interaction: This dimension focuses on the communication between learners and instructors, including feedback, guidance, and support. Strong learner-instructor interaction fosters a sense of community and helps clarify doubts.

Learner-Peers Interaction: Bower emphasizes the importance of collaboration among learners. Peer interactions can occur through discussions, group projects, and peer reviews, which enhance learning through shared knowledge and experiences.

Levels of Interactivity: Bower categorizes interactivity into different levels to indicate the depth of engagement:

Low-Level Interactivity: This includes basic interactions, such as clicking through slides or passive viewing of content.

Medium-Level Interactivity: This involves more engaging activities, such as quizzes, drag-and-drop exercises, and discussion boards.

High-Level Interactivity: At this level, learners engage in complex tasks that require higher-order thinking, such as simulations, role-playing, and collaborative projects.

Impact on Learning Outcomes: Bower's framework highlights the correlation between the level and type of interactivity and learning outcomes. Higher levels of interactivity generally lead to better engagement, motivation, and knowledge retention.

Design Implications: The framework encourages instructional designers to thoughtfully integrate various types and levels of interactivity into eLearning courses. By doing so, they can cater to diverse learning preferences and create a more engaging educational experience.

Overall, Bower's (2017) framework serves as a valuable tool for educators and instructional designers to enhance interactivity in eLearning, ultimately leading to improved learner engagement and outcomes.

Level of Detail

The level of detail provided by these frameworks also varies:

Chou's (2003) framework: This framework offers a relatively high level of detail in its conceptualization of the three interactivity levels (reactive, proactive, and mutual). The distinctions between these levels are clearly defined, providing a solid foundation for understanding the progression of interactivity.

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Huang et al.'s (2010) framework: This framework provides a more granular level of detail, as it delves into the four distinct dimensions of interactivity. The delineation between these dimensions allows for a more nuanced analysis of the various interactive features and their potential impact on learning.

Bower's (2017) framework: This framework offers a moderate level of detail, with a clear distinction between the three interactivity levels (reactive, proactive, and generative). However, the framework may be criticized for not providing as much depth as the Huang et al. (2010) model in terms of the specific dimensions of interactivity.

The choice of framework to be used in a particular context will depend on the level of detail required and the specific focus of the analysis or instructional design. Chou's (2003) framework may be more suitable for a broad, high-level understanding of interactivity, while Huang et al.'s (2010) framework may be more appropriate for a more comprehensive, multidimensional analysis. Bower's (2017) framework, with its emphasis on the generative level of interactivity, may be particularly useful in contexts where fostering learner creativity and innovation is a key priority.

Ultimately, the selection of the appropriate framework should be guided by the specific needs and requirements of the eLearning environment, the learning objectives, and the research or instructional design goals.

Theory of Interaction in the Learning Process

Interaction in learning refers to the process of learners actively engaging with the content, collaborating with others, and receiving feedback to promote deeper learning.

Garrison and Anderson's Interaction Theory Typology (2003) is a framework for understanding the types of interaction that occur in online learning environments. The typology includes three types of interaction: social, cognitive, and teaching. Here is a summary of each type of interaction:

Social Interaction: Social interaction refers to how learners interact with one another in online learning environments. This can include discussions, debates, and peer feedback (Garrison & Anderson, 2003). Social interaction is important for building a sense of community and promoting collaboration and co-construction of knowledge.

Cognitive Interaction: Cognitive interaction refers to how learners interact with the learning content in online learning environments. This can include activities such as reading, reflecting, and problem-solving (Garrison & Anderson, 2003). Cognitive interaction is important for promoting deep learning and critical thinking.

Teaching Interaction: Teaching interaction refers to how instructors interact with learners in online learning environments. This can include providing feedback, facilitating discussions, and guiding learners through the learning process (Garrison & Anderson, 2003). Teaching interaction is important for promoting effective instruction and supporting learners in their learning journey.

Garrison and Anderson's Interaction Theory Typology provides a useful framework for understanding the different types of interaction that occur in online learning environments. By focusing on social, cognitive, and teaching interaction, this typology can help instructors and designers to create more effective and engaging online learning experiences.

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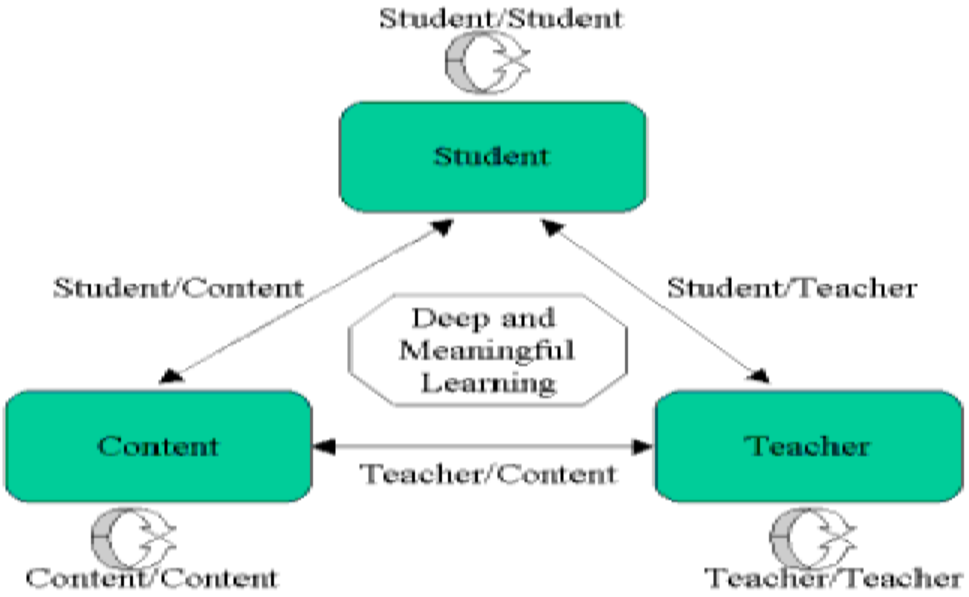

Figure 1. Garrison and Anderson's Interaction Theory Typology (2003)

Several theories explain the role of interaction in learning, including social constructivism, cognitive load theory, and the cognitive theory of multimedia learning.

Social Constructivism emphasizes the importance of social interaction and collaboration in promoting deep learning (Jonassen, 2012). According to social constructivism, learning occurs when learners actively engage with the content, collaborate with others to co-construct knowledge, and receive feedback on their performance. This theory suggests that interaction with others is an important aspect of the learning process and fostering an environment where learners can thrive can benefit from working with others to construct their understanding of the material.

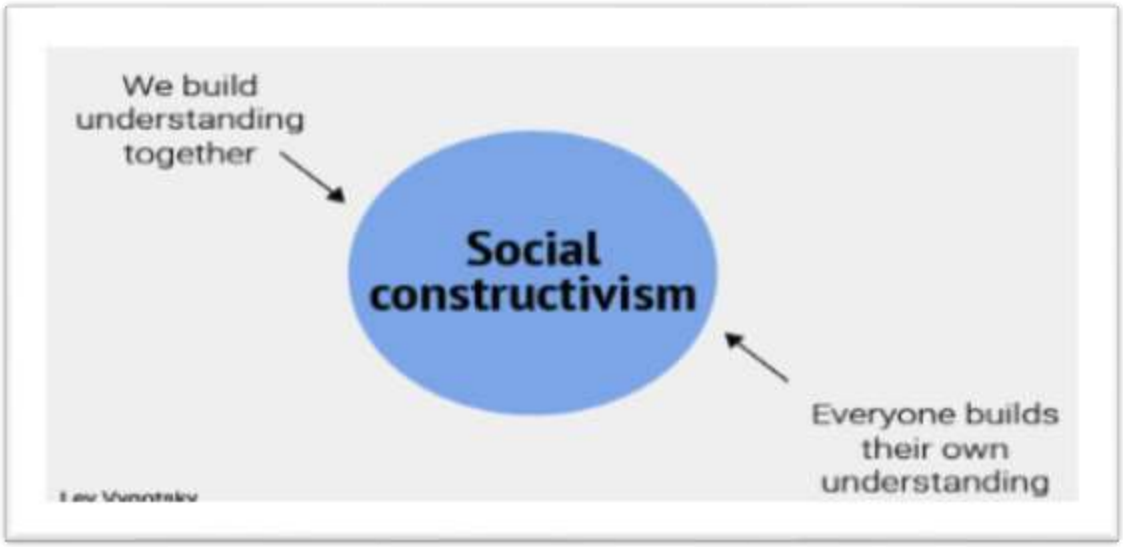

Figure 2. Social Constructivism

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The Principles of Social Constructivism

Social constructivism is a theory of learning that emphasizes the importance of social interactions and collaboration in promoting deep learning (Jonassen, 2012). According to social constructivism, learning is a social process that occurs through collaboration and discussion with others. The following are the main principles of social constructivism:

- Learning is a social process: Social constructivism argues that learning is a social process that occurs through collaboration and discussion with others (Vygotsky, 1978). Learners actively engage with the content and collaborate with others to co-construct knowledge.

- Knowledge is constructed through social interaction: Social constructivism argues that knowledge is constructed through social interaction and dialogue (Jonassen, 2012). Learners construct their understanding of the material through dialogue with others and by reflecting on their own experiences.

- Learning is contextual: Social constructivism argues that learning is contextual and is influenced by the social and cultural context in which it occurs (Wenger, 1998). Learners construct their understanding of the material based on their experiences and the context in which they are learning.

- Learning is active and experiential: Social constructivism argues that learning is an active and experiential process that occurs through engagement with the content and the environment (Dewey, 1938). Learners actively engage with the content and reflect on their experiences to construct their understanding of the material.

- Learning is collaborative: Social constructivism argues that learning is a collaborative process that occurs through interaction with others (Vygotsky, 1978). Learners collaborate with others to co-construct knowledge and support each other in the learning process.

In summary, social constructivism is a theory of learning that emphasizes the importance of social interaction, collaboration, and dialogue in promoting deep learning. The principles of social constructivism suggest that learning is a social process that occurs through active engagement with the content and collaboration with others.

Cognitive Load Theory suggests that the design of learning materials should consider the cognitive load imposed on learners (Van Merriënboer & Ayres, 2005). According to this theory, learners have limited cognitive resources, and the design of learning materials should consider the cognitive load imposed on learners to promote deeper learning. This theory suggests that interaction in learning should be designed in a way that minimizes extraneous cognitive load and maximizes germane cognitive load, allowing learners to focus on the essential elements of the learning experience.

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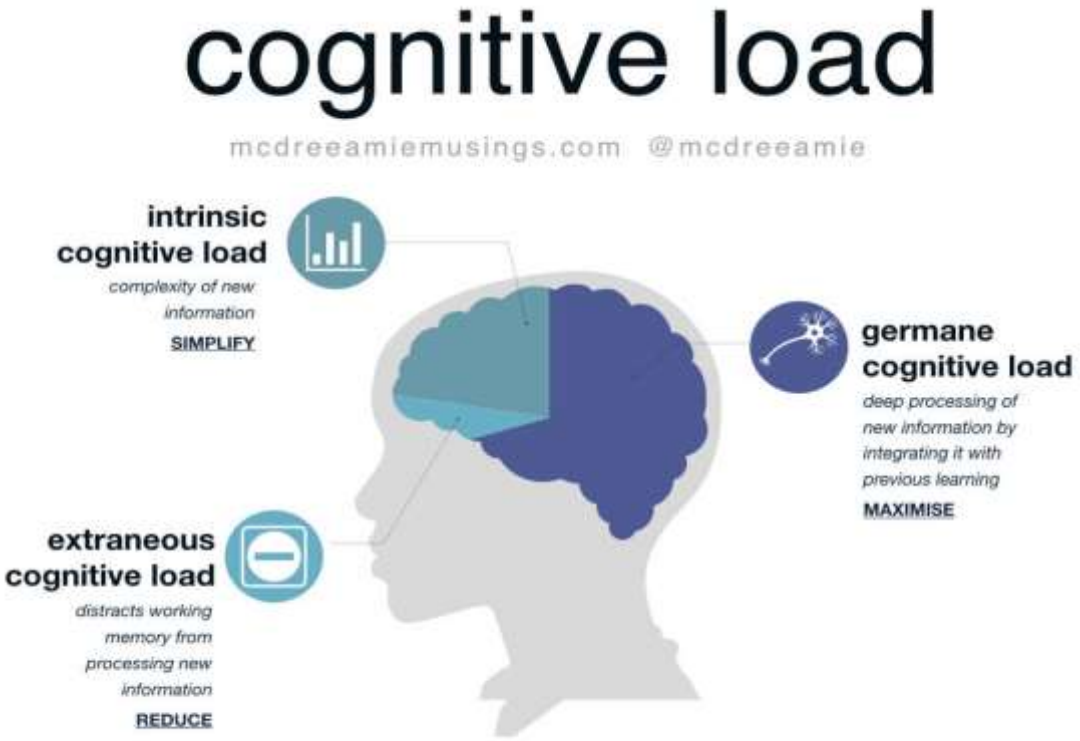

Figure 3. Cognitive Load Theory

The Principles of Cognitive Load Theory

Cognitive load theory is a theory of learning that emphasizes the importance of managing cognitive load to promote deep learning (Sweller, et al., 2011). According to cognitive load theory, learners have limited cognitive resources, and the design of learning materials should consider the cognitive load imposed on learners. The following are the main principles of cognitive load theory:

- Cognitive load: Cognitive load theory argues that learners have limited cognitive resources and that the design of learning materials should consider the cognitive load imposed on learners (Sweller et al., 2011). Cognitive load refers to the mental effort required to process the information presented in the learning materials.

- Working memory: Cognitive load theory suggests that working memory is limited and that learners can only process a limited amount of information at a time (Baddeley & Hitch, 1974). This means that the design of learning materials should consider the amount of information presented.

- Extraneous cognitive load: Cognitive load theory suggests that extraneous cognitive load should be minimized to promote deep learning (Paas, Renkl, & Sweller, 2004). Extraneous cognitive load refers to the cognitive load imposed by the design of the learning materials that are not directly related to the learning objectives.

- Intrinsic cognitive load: Cognitive load theory suggests that intrinsic cognitive load should be maximized to promote deep learning (Sweller, 1994). Intrinsic cognitive load refers to the cognitive load imposed by the complexity of the learning materials and is directly related to the learning objectives.

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- Germane cognitive load: Cognitive load theory suggests that germane cognitive load should be maximized to promote deep learning (Sweller et al., 2011). Germane cognitive load refers to the cognitive load required to process the information in a way that promotes deep learning.

In summary, cognitive load theory is a theory of learning that emphasizes the importance of managing cognitive load to promote deep learning. The principles of cognitive load theory suggest that the design of learning materials should consider the cognitive load imposed on learners, and should aim to minimize extraneous cognitive load while maximizing intrinsic and germane cognitive load.

The Cognitive Theory of Multimedia Learning suggests that learners have different channels for processing information, including visual and auditory channels (Mayer, 2009). According to this theory, the design of learning materials should consider the cognitive processes involved in processing information through different channels. This theory suggests that interaction in learning should be designed to engage multiple channels of processing, including visual and auditory channels, to promote deeper learning.

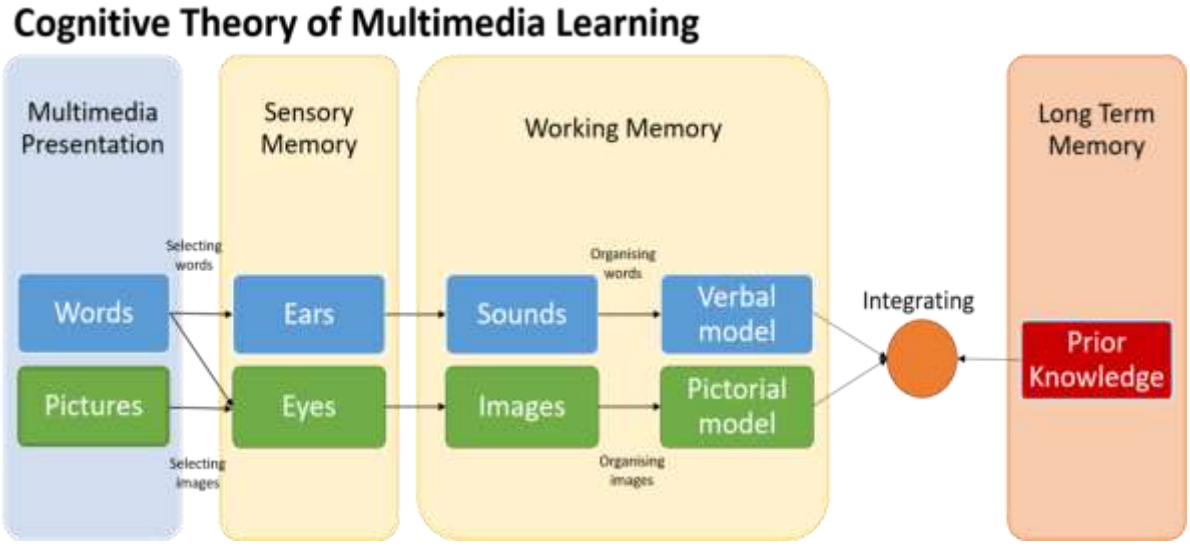

Figure 4. Cognitive Theory of Multimedia Learning

The Principles of Cognitive Theory of Multimedia Learning

The cognitive theory of multimedia learning is a theory of learning that emphasizes the importance of designing multimedia learning materials that engage multiple channels of processing (Mayer, 2009). According to this theory, learners have different channels for processing information, including visual and auditory channels, and the design of learning materials should consider the cognitive processes involved in processing information through different channels. The following are the main principles of the cognitive theory of multimedia learning:

- Dual-channel processing: The cognitive theory of multimedia learning suggests that learners process information through visual and auditory channels (Mayer, 2009). This means that the design of learning materials should consider the cognitive processes involved in processing information through both channels.

- Limited capacity: The cognitive theory of multimedia learning suggests that learners have limited cognitive resources and that the design of learning materials should consider the cognitive load imposed on learners (Sweller, et al., 2011). This means that the design of learning materials should aim to minimize extraneous cognitive load and maximize germane cognitive load.

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- Multimedia principle: The cognitive theory of multimedia learning suggests that; the use of multimedia elements, such as graphics and narration, can promote deeper learning (Mayer & Moreno, 2003). This principle suggests that the design of learning materials should consider the use of multimedia elements to engage multiple channels of processing.

- Modality principle: The cognitive theory of multimedia learning suggests that the design of learning materials should consider the modality of the information presented (Mayer & Moreno, 2003). This principle suggests that visual information is better presented in a visual modality, while auditory information is better presented in an auditory modality.

- Redundancy principle: The cognitive theory of multimedia learning suggests that the design of learning materials should avoid presenting redundant information (Mayer & Moreno, 2003). This principle suggests that presenting the same information in multiple modalities can be redundant and can increase extraneous cognitive load.

In summary, the cognitive theory of multimedia learning is a theory of learning that emphasizes the importance of designing multimedia learning materials that engage multiple channels of processing. The principles of the cognitive theory of multimedia learning suggest that the design of learning materials should consider the cognitive processes involved in processing information through different channels and aim to minimize extraneous cognitive load while maximizing germane cognitive load.

In conclusion, theories on interaction in learning emphasize the importance of active engagement, collaboration, and feedback in promoting deep learning. Social constructivism, cognitive load theory, and the cognitive theory of multimedia learning provide different perspectives on the design of learning materials that promote interaction in learning.

Levels of eLearning Interactivity

The levels of eLearning interactivity can be classified into four categories: passive, limited interaction, moderate interaction, and high interaction.

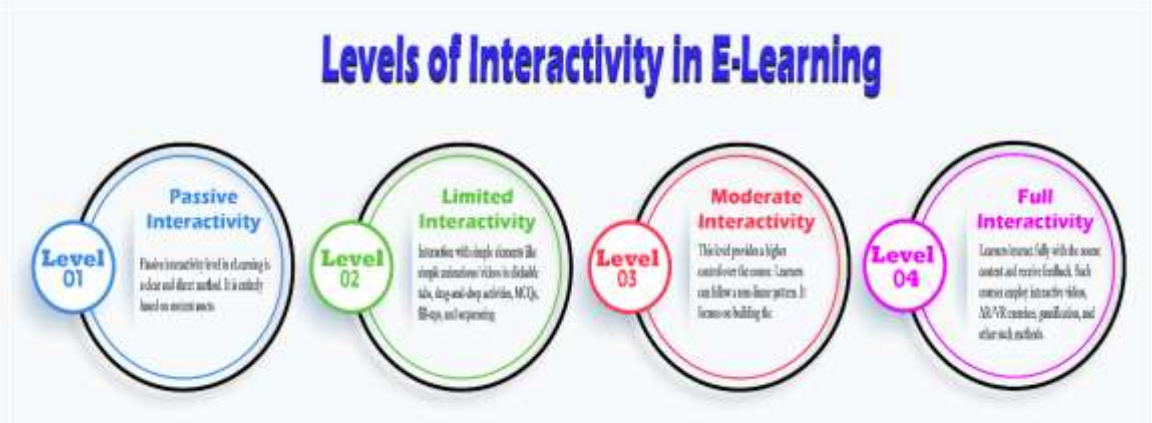

Figure 5. Levels of Interactivity

Passive Interactivity

Passive interactivity refers to eLearning content that is static and non-interactive. In this level of interactivity, learners are passive recipients of information and have no control over the learning experience. Examples of passive interactivity include text-based content, static images, and pre-recorded videos.

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Theoretical Foundation of Passive eLearning

Passive eLearning is a form of eLearning that is characterized by static, non-interactive content that requires little or no learner engagement. The theoretical foundation of passive eLearning can be traced to behaviorist theories of learning, which emphasize the importance of stimulus-response associations in shaping behavior (Clark & Mayer, 2016). According to behaviorist theory, learning occurs through the repetition of stimuli and responses, with reinforcement strengthening the association between the two.

Passive eLearning is based on the principle that learners can acquire knowledge simply by being exposed to information. This approach assumes that learners are passive recipients of information and that the role of the instructor is to present information in a clear and organized manner. Proponents of passive eLearning argue that it is a cost-effective and efficient way to deliver content to a large number of learners.

However, critics of passive eLearning argue that it is a limited form of education that fails to engage learners and promote deeper learning (Mayer, 2009). Cognitive load theory suggests that passive eLearning can lead to cognitive overload, as learners are required to process large amounts of information without opportunities for active engagement (Van Merriënboer & Ayres, 2005). This can lead to poor retention and transfer of knowledge.

The theoretical foundation of passive eLearning is rooted in behaviorist theories of learning, which emphasize the importance of stimulus-response associations in shaping behavior. While passive eLearning may be a cost-effective and efficient way to deliver content, it has limitations in promoting deeper learning and engagement. Therefore, eLearning designers should consider incorporating interactive elements into their courses to enhance learners' engagement and promote deeper learning.

Limited Interaction

Limited interaction refers to eLearning content that allows learners to interact with the content to some extent. In this level of interactivity, learners can click on buttons, select options from a drop-down menu, or answer multiple-choice questions. However, the degree of control over the learning experience is still limited. Examples of limited interaction include quizzes, drag-and-drop exercises, and simple simulations.

Theoretical Foundation of Limited Interaction eLearning

Limited Interaction eLearning refers to eLearning content that allows learners to interact with the content to some extent, but the degree of control over the learning experience is still limited. The theoretical foundation of Limited Interaction eLearning can be traced to constructivist and cognitivist theories of learning, which emphasize the importance of active engagement and meaningful learning experiences (Clark & Mayer, 2016).

According to constructivist and cognitivist theories, learning occurs when learners actively engage with the content and construct their understanding of the material. Limited Interaction eLearning provides learners with opportunities to interact with the content through activities such as quizzes, drag-and-drop exercises, and multiple-choice questions. These activities allow learners to apply their knowledge and receive feedback on their performance, which can enhance their understanding of the material.

Limited Interaction eLearning is based on the principle that learners need to be actively engaged in the learning process to promote deeper learning. Proponents of Limited Interaction eLearning argue that it provides a balance between passive and highly interactive eLearning, allowing learners to engage with the content without overwhelming them with too much interactivity.

However, critics of Limited Interaction eLearning argue that it may not provide enough opportunities for learners to engage with the content in meaningful ways (Mayer, 2009). Cognitive load theory suggests that the design of Limited Interaction eLearning should consider the cognitive load imposed on learners and

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that the level of interactivity should be appropriate for the level of complexity of the content (Van Merriënboer & Ayres, 2005).

In summary, the theoretical foundation of Limited Interaction eLearning is based on constructivist and cognitivist theories of learning, which emphasize the importance of active engagement and meaningful learning experiences. While Limited Interaction eLearning provides learners with opportunities to interact with the content, eLearning designers should consider the appropriate level of interactivity based on the complexity of the content and the cognitive load imposed on learners.

Moderate Interaction

Moderate interaction refers to eLearning content that provides learners with more control over the learning experience. In this level of interactivity, learners can navigate through the content, interact with multimedia elements, and make decisions that affect the learning experience. Examples of moderate interaction include branching scenarios, interactive case studies, and simulations.

Theoretical Foundation of Moderate Interaction eLearning

Moderate Interaction eLearning refers to eLearning content that provides learners with more control over the learning experience, allowing them to navigate through the content, interact with multimedia elements, and make decisions that affect the learning experience. The theoretical foundation of Moderate Interaction eLearning is based on constructivist and cognitivist theories of learning, which emphasize the importance of active engagement and meaningful learning experiences (Clark & Mayer, 2016).

According to constructivist and cognitivist theories, learning occurs when learners actively engage with the content and construct their understanding of the material. Moderate Interaction eLearning provides learners with opportunities to engage with the content through activities such as branching scenarios, interactive case studies, and simulations. These activities allow learners to apply their knowledge and receive feedback on their performance, which can enhance their understanding of the material.

Moderate Interaction eLearning is based on the principle that learners need to be actively engaged in the learning process to promote deeper learning. Proponents of Moderate Interaction eLearning argue that it provides a balance between passive and highly interactive eLearning, allowing learners to engage with the content in meaningful ways without overwhelming them with too much interactivity.

However, critics of Moderate Interaction eLearning argue that it may not provide enough opportunities for learners to engage with the content in highly immersive ways (Mayer, 2009). Cognitive load theory suggests that the design of Moderate Interaction eLearning should consider the cognitive load imposed on learners and that the level of interactivity should be appropriate for the level of complexity of the content (Van Merriënboer & Ayres, 2005).

In summary, the theoretical foundation of Moderate Interaction eLearning is based on constructivist and cognitivist theories of learning, which emphasize the importance of active engagement and meaningful learning experiences. While Moderate Interaction eLearning provides learners with opportunities to engage with the content in more meaningful ways than Limited Interaction eLearning, eLearning designers should consider the appropriate level of interactivity based on the complexity of the content and the cognitive load imposed on learners.

High Interaction

High interaction refers to eLearning content that provides learners with a fully immersive and interactive learning experience. In this level of interactivity, learners can engage with realistic simulations, participate in virtual reality environments, and collaborate with others in real time. Examples of high interaction include virtual labs, multiplayer games, and social learning platforms.

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Theoretical Foundation of High Interaction eLearning

High Interaction eLearning refers to eLearning content that provides learners with a high degree of control over the learning experience, allowing them to actively engage with the content, collaborate with peers, and receive personalized feedback. The theoretical foundation of high-interaction eLearning is based on constructivist and social constructivist theories of learning, which emphasize the importance of active engagement, collaboration, and social interaction in promoting deep learning (Jonassen, 2012; Garrison & Anderson, 2003).

According to constructivist and social constructivist theories, learning occurs when learners actively engage with the content, construct their understanding of the material, and collaborate with others to co-construct knowledge. High Interaction eLearning provides learners with opportunities to engage with the content through activities such as problem-based learning, collaborative learning, and peer review. These activities allow learners to apply their knowledge, receive feedback, and co-construct knowledge with their peers.

High Interaction eLearning is based on the principle that learners need to be actively engaged in the learning process, collaborate with others, and receive feedback to promote deep learning. Proponents of Interaction eLearning argue that it provides a highly immersive and engaging learning experience that promotes deep learning.

However, critics of high-interaction eLearning argue that it may not be suitable for all learners, as some learners may prefer to learn in more independent and self-directed ways (Mayer, 2009). Cognitive load theory suggests that the design of High Interaction eLearning should consider the cognitive load imposed on learners and that the level of interactivity should be appropriate for the level of complexity of the content (Van Merriënboer & Ayres, 2005).

In summary, the theoretical foundation of High Interaction eLearning is based on constructivist and social constructivist theories of learning, which emphasize the importance of active engagement, collaboration, and social interaction in promoting deep learning. While High Interaction eLearning provides learners with highly immersive and engaging learning experiences, eLearning designers should consider the appropriate level of interactivity based on the complexity of the content, the cognitive load imposed on learners, and the preferences of the learners.

Pedagogical Benefits of Interactivity in eLearning

Interactivity is widely recognized as a crucial element in the design and delivery of effective eLearning environments. The incorporation of interactive features and functionalities can yield significant pedagogical benefits for learners, as demonstrated by the following research findings:

- Increased Engagement and Motivation: Numerous studies have found that interactivity positively impacts learner engagement and motivation in eLearning. For example, a study by Halili et al. (2011) revealed that the use of interactive features, such as simulations and games, enhanced learners' engagement and intrinsic motivation to participate in the learning process.

- Improved Knowledge Retention and Transfer: Interactivity can enhance the learner's ability to retain and apply the acquired knowledge. Moreno and Mayer (2007) found that interactive multimedia learning environments, which allow learners to actively manipulate and control the learning content, led to better knowledge retention and transfer compared to more passive, non-interactive environments.

- Facilitation of Active Learning: Interactive eLearning environments encourage learners to actively participate in the learning process, moving beyond passive consumption of content. Mayer (2014) argues that interactive features, such as quizzes, simulations, and discussions, promote active learning and deeper cognitive processing, leading to more meaningful and lasting learning outcomes.

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- Personalization and Adaptive Learning: Interactivity enables the creation of personalized and adaptive learning experiences. By tracking learners' interactions, preferences, and performance, eLearning systems can dynamically adjust the content, pace, and level of difficulty to cater to individual learning needs (Hwang et al., 2012).

- Collaborative and Social Learning: Interactive features in eLearning can foster collaborative and social learning experiences. Tools such as discussion forums, group projects, and peer-to-peer feedback mechanisms facilitate the sharing of knowledge, the exchange of ideas, and the development of social and communication skills (Chu & Lai, 2017).

- Increased Learner Autonomy and Self-Regulation: Interactivity in eLearning can empower learners to take a more active role in their own learning process. By providing interactive tools and opportunities for exploration, eLearning environments can promote learner autonomy, self-regulation, and the development of metacognitive skills (Broadbent & Poon, 2015).

These pedagogical benefits of interactivity in eLearning have been consistently supported by research, highlighting the importance of incorporating interactive features and functionalities in the design and delivery of online and technology-enhanced learning experiences.

Thinking, and Higher-Order Learning Outcomes

Interactivity in eLearning environments plays a crucial role in promoting deeper understanding, critical thinking, and the achievement of higher-order learning outcomes. The interactive features and functionalities incorporated into eLearning design can facilitate these pedagogical objectives in the following ways:

Deeper Understanding: Interactive content, such as simulations, visualizations, and manipulable models, allows learners to actively explore and engage with the learning material, leading to a more profound understanding of concepts and phenomena (Mayer, 2014). Opportunities for learners to receive immediate feedback, explanations, and guidance during interactive tasks can deepen their comprehension and address misconceptions (Shute, 2008). Interactive learning activities that require learners to make predictions, test hypotheses, and draw conclusions promote the construction of meaningful knowledge structures (Bransford et al., 2000).

Critical Thinking: Interactive features that encourage learners to analyze, evaluate, and synthesize information, such as interactive case studies, problem-solving exercises, and decision-making scenarios, foster the development of critical thinking skills (Dabbagh & Fake, 2017). Collaborative interactive activities, such as online discussions and group projects, enable learners to engage in the exchange of diverse perspectives, consider alternative viewpoints, and develop their critical reasoning abilities (Chu & Lai, 2017). Interactivity that supports learners in self-reflection, monitoring their learning progress, and adjusting their strategies promotes the development of metacognitive skills, which are essential for critical thinking (Broadbent & Poon, 2015).

Higher-order Learning Outcomes: Interactive learning experiences that require learners to apply, analyze, evaluate, and create content, rather than solitary recall information, align with the higher levels of Bloom's Taxonomy of educational objectives (Anderson & Krathwohl, 2001). Interactive features that enable learners to engage in complex problem-solving, design thinking, and creative activities can foster the development of higher-order skills, such as innovation, problem-solving, and decision-making (Bower, 2017). Adaptive and personalized interactivity can challenge learners at appropriate levels, gradually increasing the complexity and cognitive demands, thereby supporting the achievement of advanced learning goals (Hwang et al., 2012).

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By leveraging the pedagogical benefits of interactivity, eLearning environments can effectively foster deeper understanding, critical thinking, and higher-order learning outcomes attainment, ultimately enhancing the overall quality and effectiveness of the learning experience.

Design and Implementation Considerations for Optimal Interactivity in eLearning

To ensure the effective integration of interactivity in eLearning environments, several design and implementation considerations must be considered. These considerations are informed by research and best practices in the field of interactive learning design:

Instructional Alignment

Interactivity should be designed to align with the specific learning objectives, content, and instructional strategies of the eLearning program (Mayer, 2014).

The interactive features should be carefully selected and integrated to support the desired learning outcomes, cognitive processes, and knowledge construction (Dalgarno & Lee, 2010).

User-Centered Design

Interactivity should be designed with the learners' needs, abilities, and preferences in consideration, ensuring a seamless and intuitive user experience (Zaharias & Koutsabasis, 2012).

Usability testing and iterative design processes should be employed to gather feedback and refine the interactive elements based on learner feedback and performance (Hwang et al., 2012).

Cognitive Load Management

Interactivity should be designed to manage cognitive load and support learners' information processing capacity (Sweller et al., 2011).

The level of interactivity, complexity, and multimedia elements should be carefully balanced to avoid overwhelming the learners and interfering with their learning (Moreno & Mayer, 2007).

Feedback and Guidance

Interactive features should provide timely, relevant, and constructive feedback to learners, enabling them to monitor their progress, identify areas for improvement, and adjust their learning strategies (Shute, 2008).

Appropriate scaffolding and guidance should be integrated within the interactive elements to support learners in navigating the learning tasks and achieving the desired outcomes (Hmelo-Silver et al., 2007).

Adaptive and Personalized Interactivity

Interactivity should be designed to adapt to individual learners' needs, preferences, and learning styles, providing personalized learning experiences (Hwang et al., 2012).

Adaptive algorithms and learning analytics can be leveraged to dynamically adjust the interactive content, level of difficulty, and support based on learners' performance and progress (Bower, 2017).

Collaborative and Social Interactivity

Interactive features should support collaborative learning, enabling learners to engage in discussions, share knowledge, and work collectively on learning tasks (Chu & Lai, 2017).

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Social interactive elements, such as discussion forums, peer feedback mechanisms, and virtual learning communities, can foster social learning and the development of communication and collaboration skills (Wang, 2017).

Technological Considerations

The choice and implementation of interactive technologies should consider factors such as platform compatibility, device responsiveness, media optimization, and accessibility for diverse learners (Mayer, 2014).

Emerging technologies, such as virtual reality, augmented reality, and game-based learning, can be leveraged to enhance the interactivity and immersiveness of the eLearning experience (Bower, 2017).

By addressing these design and implementation considerations, eLearning developers can create interactive learning environments that effectively foster learner engagement, deeper understanding, and the achievement of desired learning outcomes.

Gaps and Limitations in the Current Research on Design and Implementation Considerations for Optimal Interactivity in eLearning

While the existing research provides valuable insights into the design and implementation considerations for optimal interactivity in eLearning, there are several gaps and limitations that warrant further exploration:

Contextual Factors

The majority of the research focuses on general design principles, with limited attention to the specific contextual factors that may influence the effectiveness of interactive elements, such as the subject matter, target audience, and learning environment (Moore et al., 2017).

More research is needed to understand how contextual factors interact with the design and implementation of interactivity and how to tailor interactive features accordingly.

Empirical Evaluation

Much of the existing research relies on theoretical frameworks and best practices, with a lack of robust empirical evaluation of the impact of specific interactive features on learning outcomes and engagement (Dalgarno & Lee, 2010).

More comprehensive, longitudinal studies are needed to assess the effectiveness of interactive elements in eLearning environments, including the measurement of learning gains, learner satisfaction, and transfer of knowledge and skills.

Personalization and Adaptability

While the importance of adaptive and personalized interactivity is recognized, the research on practical implementation and evaluation of such approaches is limited (Hwang et al., 2012).

Exploring the use of learning analytics, artificial intelligence, and adaptive algorithms to dynamically personalize the interactive experience could contribute to a better understanding of this area.

Collaborative and Social Interactivity

The research on the design and implementation of collaborative and social interactive features in eLearning is relatively sparse, with a need for more in-depth exploration of the pedagogical and technological aspects of these approaches (Chu & Lai, 2017).

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Investigating the facilitation of effective online discussions, peer feedback mechanisms, and virtual communities could provide valuable insights into enhancing the social dimensions of interactivity.

Emerging Technologies

The current research mostly focuses on traditional interactive elements, such as multimedia, simulations, and game-based learning, with limited exploration of the potential of emerging technologies, such as virtual reality, augmented reality, and mixed reality (Bower, 2017).

Further research is needed to understand the design and implementation considerations for these innovative interactive technologies and their impact on eLearning.

Accessibility and Inclusivity

While the importance of accessibility is recognized, the research on designing and implementing interactive features that cater to diverse learners, including those with disabilities, is limited (Alshammari et al., 2020).

Exploring inclusive design principles and the integration of accessibility features within interactive eLearning environments could contribute to more equitable and accessible learning experiences.

Addressing these gaps and limitations in the current research could lead to a more comprehensive understanding of the design and implementation considerations for optimal interactivity in eLearning, ultimately improving the effectiveness, engagement, and inclusivity of online learning experiences.

Future Research Directions to Address Gaps in Interactivity in eLearning

To address the gaps and limitations identified in the previous section, the following future research directions are proposed:

Contextual Factors

Conduct in-depth case studies and comparative analyses to investigate how the design and implementation of interactive elements in eLearning are influenced by specific contextual factors, such as subject matter, target audience, and learning environment.

Develop frameworks and guidelines that enable the tailoring of interactive features to different learning contexts, subject domains, and learner profiles.

Empirical Evaluation

Design and implement longitudinal, quasi-experimental, or randomized controlled studies to rigorously evaluate the impact of specific interactive features on learning outcomes, engagement, and knowledge transfer.

Utilize mixed-methods approaches, combining quantitative assessments of learning gains with qualitative analyses of learner experiences, perceptions, and behaviors.

Personalization and Adaptability

Explore the use of learning analytics, artificial intelligence, and adaptive algorithms to dynamically personalize the interactive experience based on learner performance, preferences, and learning styles.

Investigate the design and implementation of adaptive eLearning systems that can automatically adjust the level of interactivity, content complexity, and support based on individual learner needs.

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Collaborative and Social Interactivity

Investigate the design and facilitation of effective online discussion forums, peer feedback mechanisms, and virtual learning communities to enhance the collaborative and social dimensions of interactivity.

Examine the impact of collaborative and social interactive features on the development of communication, teamwork, and problem-solving skills among learners.

Emerging Technologies

Explore the design and implementation considerations for integrating emerging technologies, such as virtual reality, augmented reality, and mixed reality, into eLearning environments to create more immersive and engaging interactive experiences.

Evaluate the effectiveness of these innovative interactive technologies in supporting different learning objectives, cognitive processes, and knowledge construction.

Accessibility and Inclusivity

Investigate the design and implementation of interactive features that cater to diverse learners, including those with disabilities, to ensure equitable and inclusive eLearning experiences.

Develop and evaluate inclusive design principles and the integration of accessibility features within interactive eLearning environments.

By pursuing these future research directions, the eLearning research community can contribute to a more comprehensive understanding of the design and implementation considerations for optimal interactivity, leading to the development of more effective, engaging, and inclusive online learning experiences.

Research Methodology

The literature review and content analysis serve as a robust research methodology for the exploration of interactivity in eLearning. This approach offers several key benefits and considerations:

Comprehensive Understanding

The literature review allows for a thorough examination of the existing research, encompassing a wide range of studies, theories, and perspectives on interactivity in eLearning.

By synthesizing the findings from multiple sources, the research team can develop a comprehensive understanding of the current state of knowledge in this domain.

Identification of Gaps and Opportunities

The content analysis of the literature enables the identification of gaps, inconsistencies, and areas that require further investigation.

This analysis helps to pinpoint emerging trends, methodological limitations, and contextual factors that may influence the effectiveness of interactivity in eLearning.

Theoretical and Conceptual Foundations

The literature review and content analysis provide a solid theoretical and conceptual foundation for the research, ensuring that the proposed study is grounded in established frameworks and theories.

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This foundation enhances the overall rigor and validity of the research.

Informing Research Design

The insights gained from the literature review and content analysis can inform the development of subsequent research phases, such as the design of empirical studies, the selection of appropriate methodologies, and the identification of relevant variables and measures.

Establishing Credibility and Relevance

The thorough and systematic review of the existing literature demonstrates the research team's comprehensive knowledge of the field and their ability to critically analyze and synthesize the available evidence.

This enhances the credibility and relevance of the proposed research within the academic and practitioner communities.

Iterative and Ongoing Process

The literature review and content analysis should be an iterative and ongoing process, as new research is continuously published in the field.

Regular updates and refinements to the literature review will ensure the research remains current and responsive to emerging trends and developments.

Literature Review and Content Analysis

The foundation of the proposed research methodology is a comprehensive and systematic review of the existing literature on interactivity in eLearning. This literature review will serve as a crucial step in understanding the current state of research, identifying key themes and patterns, and informing the development of subsequent research phases.

The literature review will employ a structured and rigorous approach, drawing from relevant databases and scholarly sources to identify and analyze the most influential and up-to-date studies on interactivity in eLearning. The search strategy will include keywords and terms related to eLearning, interactivity, interactive features, learning outcomes, engagement, and knowledge transfer, among others.

Once the relevant literature has been identified, a content analysis will be conducted to synthesize the research findings. This analysis will focus on several key aspects, including:

- Conceptual and Theoretical Frameworks: Examining the various definitions, conceptualizations, and theoretical underpinnings of interactivity in eLearning, as presented in the literature.
- Levels and Types of Interactivities: Identifying and analyzing the different taxonomies, frameworks, or categorizations of interactive features and their levels of complexity and sophistication.
- Design and Implementation Considerations: Exploring the design principles, strategies, and implementation approaches employed in the development of interactive eLearning environments.
- Empirical Findings: Synthesizing the empirical evidence on the impact of interactivity on learning outcomes, engagement, and knowledge transfer, as well as the contextual factors that may influence these outcomes.

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- Methodological Approaches: Evaluating the research methodologies, data collection techniques, and analytical methods used in the existing studies to understand the strengths, limitations, and potential areas for improvement.

The content analysis involves systematic coding, categorization, and thematic analysis of the literature, facilitated by the use of qualitative data analysis software or other relevant tools. This process will enable the identification of key themes, patterns, and gaps in the research, which will then inform the development of the subsequent research phases.

By conducting a comprehensive literature review and content analysis, the researcher gains a thorough understanding of the current state of knowledge on interactivity in eLearning, as well as the methodological approaches employed in the field. This foundational step will ensure that the proposed research directions and methodologies are grounded in the existing literature and address the most pressing gaps and areas for further investigation.

Results & Discussion

The comprehensive literature review and content analysis on interactivity in eLearning have yielded several key findings and insights that inform the understanding of this important topic.

Conceptualization of Interactivity

The literature review revealed a diverse range of conceptualizations and definitions of interactivity in the eLearning context.

While some studies focused on the technological aspects of interactivity, such as the use of multimedia features and interactive tools, others emphasized the cognitive and behavioral dimensions, including learner engagement, active participation, and knowledge construction.

A synthesis of these perspectives suggests that interactivity in eLearning is a multifaceted construct, encompassing both the design of interactive features and the learners' cognitive and behavioral responses to these features.

Levels and Types of Interactivities

The analysis of the literature identified several taxonomies and frameworks that categorize the different levels and types of interactivities in eLearning.

These range from low-level interactivity, such as simple navigation and information retrieval, to high-level interactivity, involving complex problem-solving, simulation, and collaborative learning.

The research indicates that the effectiveness of interactivity in eLearning is closely tied to the alignment between the type of interactivity and the desired learning outcomes and instructional goals.

Design and Implementation Considerations

The literature review revealed several key design principles and implementation strategies that contribute to the effective integration of interactive features in eLearning environments.

These include the consideration of learner preferences and characteristics, the alignment of interactivity with instructional objectives, the incorporation of adaptive and personalized learning experiences, and the importance of instructor support and facilitation.

The research also highlighted the need for a user-centered design approach, involving learners and subject matter experts in the development and refinement of interactive eLearning experiences.

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Empirical Findings on Learning Outcomes

The synthesis of empirical studies demonstrated the potential of interactivity to enhance various learning outcomes, such as knowledge acquisition, skill development, and knowledge transfer.

However, the research also revealed that the impact of interactivity on learning is not always straightforward and can be influenced by factors such as learner characteristics, task complexity, and instructional context.

Some studies reported mixed or inconclusive findings, suggesting the need for further investigation to understand the precise mechanisms and boundary conditions that govern the relationship between interactivity and learning outcomes.

Methodological Approaches and Limitations

The content analysis of the research methodologies employed in the existing studies highlighted both the strengths and limitations of the current approaches.

While many studies utilized experimental, quasi-experimental, or case study designs, there was a need for more longitudinal, multi-method, and interdisciplinary investigations to capture the nuances and complexities of interactivity in eLearning.

The research also identified the potential for leveraging learning analytics and user-centered design techniques to enhance the understanding and evaluation of interactive eLearning experiences.

The findings from this comprehensive literature review and content analysis provide a solid foundation for the development of future research directions and practical implications. The insights gained can inform the design and implementation of interactive eLearning environments, as well as guide the selection of appropriate research methodologies to further explore this important area of eLearning. By addressing the identified gaps and building upon the existing knowledge, the research community can continue to advance the understanding and application of interactivity to enhance the effectiveness and engagement of online learning experiences.

Conclusion and Future Research Directions

The comprehensive literature review and content analysis on interactivity in eLearning have yielded valuable insights and highlighted several important directions for future research.

Conclusion

The findings from this study demonstrate the multifaceted and complex nature of interactivity in eLearning. The literature review revealed a diverse range of conceptualizations, taxonomies, and implementation strategies related to interactive features and their impact on learning outcomes. While the research has shown the potential of interactivity to enhance learner engagement, knowledge acquisition, and skill development, the relationship between interactivity and learning is not always straightforward and can be influenced by various contextual and learner-specific factors.

The synthesis of the existing empirical evidence suggests that the effectiveness of interactivity in eLearning is closely tied to the alignment between the type of interactivity, the instructional objectives, and the learners' characteristics and preferences. Furthermore, the analysis of the methodological approaches highlighted the need for more longitudinal, multi-method, and interdisciplinary investigations to capture the nuances and complexities of interactivity in eLearning.

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Future Research Directions

Based on the insights gained from this literature review and content analysis, several promising avenues for future research have emerged:

Toward a Unified Conceptual Framework

Develop a comprehensive and integrative conceptual framework that captures the multidimensional nature of interactivity in eLearning, including the technological, cognitive, and behavioral aspects.

Explore the potential for interdisciplinary collaboration to synthesize theories and models from various fields, such as instructional design, educational psychology, and human-computer interaction.

Empirical Investigations of Interactivity Levels and Types

Conduct in-depth empirical studies to further explore the impact of different levels and types of interactivities on learning outcomes, engagement, and knowledge transfer.

Investigate the contextual factors and learner characteristics that may moderate the effectiveness of various interactive features.

User-Centered Design and Evaluation Approaches

Adopt a user-centered design approach, involving learners and subject matter experts in the development and refinement of interactive eLearning experiences.

Leverage learning analytics and user experience research methods to gain a deeper understanding of how learners interact with and respond to different interactive features.

Longitudinal and Cross-Disciplinary Studies

Undertake longitudinal studies to examine the long-term effects of interactivity on learners' knowledge retention, skill development, and learning transfer.

Encourage collaborative research efforts across disciplines, such as educational technology, cognitive psychology, and computer science, to capture the multifaceted nature of interactivity in eLearning.

Adaptive and Personalized Interactivity

Explore the potential of adaptive and personalized interactivity, where the interactive features are tailored to individual learner needs, preferences, and skill levels.

Investigate the design principles and implementation strategies for creating adaptive and personalized interactive eLearning environments.

By pursuing these future research directions, the academic and practitioner communities can continue to advance the understanding and application of interactivity in eLearning, ultimately enhancing the effectiveness, engagement, and overall quality of online learning experiences.

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