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# Enhancing Learning Experiences through Interactive Visual Communication Design in Online Education

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**ABSTRACT**

This article delves into the effects of interactive visual communication design on online learning, as learners increasingly turn to digital tools. The research aims to assess how interactive visual communication design can improve learning experiences in online education, focusing on its influence on student engagement, knowledge retention, and inclusivity. By examining these aspects, the study offers insights into crafting more effective digital learning environments. Furthermore, it puts forth hypotheses suggesting that integrating visual communication design elements into courses can lead to greater effectiveness compared to traditional instructional methods. Employing a qualitative systematic literature review, the study investigates the potential of interactive visual communication design to transform online education. Five pertinent articles meeting strict inclusion and exclusion criteria are meticulously chosen for analysis based on relevance, recent publication, and their contributions to understanding the efficacy and challenges of visual design in digital education. Additionally, synthesizing findings from 30 selected papers yields a comprehensive model comprising a detailed set of outcomes and fundamental elements related to interactive visual communication design in online learning. This model revolves around key themes such as Emergency Remote Teaching (ERT), various types of Video Lectures, Challenges in Online Learning Behaviour in Higher Education, and Future Trends in e-learning. Notably, the study's findings highlight that interactive visual design substantially enhances student engagement, facilitates better knowledge retention, and promotes inclusivity in online learning settings. These insights culminate in a holistic model that underscores the transformative potential of visual design elements in the realm of digital education.



## Introduction

The advent of online education has precipitated a paradigm shift in conventional pedagogical approaches, rendering education and knowledge more accessible than ever before. Kuong (2015) contends that the transition from traditional classroom settings to virtual platforms introduces formidable obstacles that must be surmounted to uphold an engaging, productive, and inclusive learning milieu, deemed imperative for the comprehensive education of every student. Consequently, design considerations in online education assume paramount significance, leveraging immersive visual communication modalities. Furthermore, Martin et al. (2018b) elucidate that contemporary instructional frameworks often entail students utilizing tangible resources, engaging in face-to-face interactions, and delving into burgeoning concepts. The forces of globalization and technological advancement have engendered a recalibration of instructional

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methodologies in online education, prompting a substantive reconfiguration of its structural framework. The efficacy of online education hinges not only on the quality of its content but also on the astuteness of its learning environment design. Furthermore, Sun and Chen (2016) assert that while many online courses furnish requisite information, sustaining student motivation necessitates concerted endeavours. Despite adhering to standardized curricula, these online courses are adept at fostering retention and catering to diverse learning modalities. In an era where digital technologies pose distractions, the integration of interactive visual components assumes paramount importance. Additionally, Gillett-Swan (2017) evaluates that the incorporation of interactive visual communication enriches online education by harnessing a plethora of multimedia resources, facilitated by the burgeoning popularity of online learning platforms. This repertoire encompasses cinematic productions, animations, informative graphics, and interactive simulations, augmenting the aesthetic appeal of educational materials and engendering active student engagement, thereby enhancing comprehension. Animated simulations, for instance, serve as potent pedagogical tools in elucidating intricate scientific concepts by offering visual representations of dimensional complexities.

The transition from traditional face-to-face classroom instruction to online learning platforms signifies a fundamental shift in the delivery and experience of education. While this transition has ushered in unprecedented opportunities for learning irrespective of geographical constraints, it has also brought forth a myriad of challenges for educators and students alike. These challenges encompass diminished student engagement and interaction, the intricacies involved in crafting inclusive learning environments that cater to diverse learning styles, and the hurdles associated with effectively conveying complex concepts within the online milieu. These challenges, as highlighted by Martin and Bolliger (2018a), have the potential to compromise the efficacy of online learning, potentially leading to elevated dropout rates and diminished student satisfaction when juxtaposed with traditional learning modalities. Given the heterogeneous backgrounds from which students originate, online education holds considerable promise, necessitating a burgeoning focus on creative visual communication design. Emerging technologies such as Virtual Reality (VR), Augmented Reality (AR), and gamification, as elucidated by Castro and Tumibay (2021), are increasingly being leveraged to enhance the online learning experience. Educators and instructional designers can augment online learning environments by meticulously observing the impact of these design elements on students' motivation, comprehension, and retention, as suggested by Hwang et al. (2015). Consequently, there exists a pressing need to examine the efficacy of employing visual interaction techniques in online instruction to bolster digital educational formats.

In light of these considerations, the influence of visual communication design on online education merits thorough exploration. Educators are thus encouraged to embrace novel tools such as interactive infographics, data visualization dashboards, virtual reality simulations, and motion graphics to enrich the online learning experience. To this end, the following research objectives are delineated to probe various facets pertinent to the study topic.

**Objective 1***: Examine the Role of Interactive Visual Communication Design in Enhancing Student Engagement in Online Education*
**Objective 2***: Investigate the Impact of Interactive Visual Elements on Knowledge Retention in Online Learning Environments*
**Objective 3***: Explore the Contribution of Visual Communication Design to Inclusive Learning Environments in Online Education*
**Objective 4:** *Construct a Comprehensive Model through a Systematic Review of Literature to Synthesize Best Practices and Key Elements of Interactive Visual Communication Design in Online Education.*

In the realm of online learning, the challenge of lower retention rates compared to

traditional classes necessitates innovative solutions. This research investigates how interactive visual communication design can address these challenges. By integrating techniques such as animations and simulations, the study demonstrates the potency of visual design in enhancing educational outcomes beyond current online methods. The transition to online education presents unique issues such as decreased student engagement and retention (Serban & Vescan, 2019), which this research endeavours to address by examining the impact of interactive visual communication design. Ultimately, this study aims to elucidate the influence of visual design variables to offer evidence-based guidance for instructors and designers in e-learning environments.

## Literature Review

The advancement towards online education necessitates a re-evaluation of educational methodologies. This literature review scrutinizes the impact of interactive visual communication design on student engagement, knowledge retention, and the establishment of inclusive learning environments within the domain of online education.

### *Enhancing Student Engagement through Interactive Visual Communication Design*

The transition from traditional classroom instruction to e-learning has presented significant challenges in maintaining student engagement, as noted by Dixson et al. (2017), who observed immediate issues arising from this shift. The integration of interactive visual elements plays a pivotal role in fostering engagement and retention in online education. While face-to-face interactions afford instructors the opportunity to utilize visual cues, emotional responses, and immediate feedback to cultivate a vibrant and dynamic learning environment, replicating such experiences in virtual settings necessitates effective interactive visual communication design, as emphasized by Serrano et al. (2019). The aim is to emulate real-world behaviours and facilitate meaningful interaction within the virtual environment.

Moreover, research by Bond and Bedenlier (2019) underscores that interactive visuals can engender a multisensory immersive learning experience, further highlighting their efficacy in online education. Despite the recognized benefits, it is imperative to carefully consider potential drawbacks, such as overwhelming learners with excessive visual stimuli and issues related to accessibility for individuals with disabilities or limited access to advanced technological resources. Additionally, the utilization of high-quality visuals may incur heightened production costs and time constraints, potentially impeding their widespread adoption.

An examination of the limitations associated with interactive visual design in online education serves to inform strategies aimed at mitigating these barriers and ensuring effective and inclusive teaching experiences. While these components cater to diverse learning styles and render knowledge dynamically accessible, it is worth noting the static nature of spoken-word content, as depicted in the Figure 1.

Graphics, encompassing both infographics and diagrams, serve as effective tools for condensing complex information into easily comprehensible and memorable visual formats. The capacity of visuals to elucidate statistical data and illustrate relationships between concepts is widely recognized. Conducting an in-depth exploration into the benefits of these graphical aids for visual learners and their role in expediting information assimilation is imperative for educational content developers (Tarkhova et al., 2020). Furthermore, interactive simulations afford students the opportunity to manipulate various variables within a virtual environment, thereby enabling real-time visualization of theoretical models. This functionality proves indispensable in disciplines where the practical application of concepts is as crucial as theoretical understanding. Interactive visual communication empowers students to actively engage with their studies and master their subjects (Gray & DiLoreto, 2016). Encouraging active participation within the design

framework, facilitated through clickable elements, drag-and-drop features, or immersive virtual environments, fosters student focus and accountability for their learning—a pivotal aspect of their educational development. Interactive images have the potential to enhance critical thinking skills and promote audience engagement, while interactive models enable students to actively learn, synthesize, and apply information (Rands & Gansemer-Topf, 2017). Such approaches align with contemporary educational philosophies that prioritize experiential learning and active involvement in knowledge acquisition.

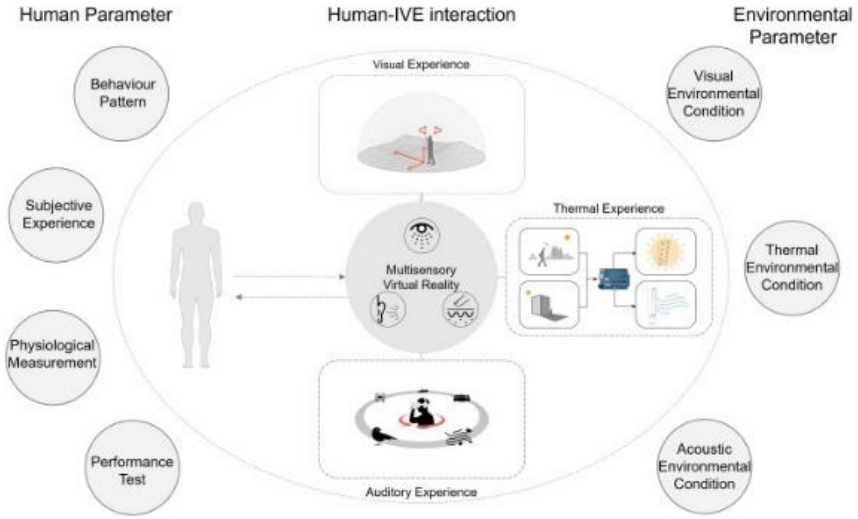


**Figure 1:** *Immersive Multisensory Virtual Reality Approach to the Study of Human-Built Environment Interactions* (Lyu et al., 2023).

### *Impact of Interactive Visual Elements on Knowledge Retention*

Given the evolving nature of online education, scholars are compelled to prioritize comprehension and information retention among learners. Within this framework, Huang et al. (2019) assert that conventional textual presentations are perceived as inadequate in capturing and sustaining the attention of online learners. Incorporating visual elements such as photographs, infographics, graphs, and dynamic charts can effectively surmount these challenges, rendering learning more engaging and efficacious due to the inherent appeal of visual stimuli. Multimodal learning, integrating both written and visual information, has demonstrated enhanced knowledge acquisition in the realm of online education. Visual aids facilitate content encoding and retention by providing cognitive scaffolding.

Moreover, Wang et al. (2020) underscore the role of infographics in elucidating complex relationships and concepts, owing to their visual allure and ease of assimilation. This attribute renders intricate ideas and interconnections more accessible to learners. Diagrams, meanwhile, facilitate the recollection of intricate subjects by furnishing spatial representations that simplify complex notions. Visual elements enable students to envisage novel concepts more readily, with the impressions captured and retained in their minds over extended periods. Clark and Mayer (2023) ascertain that online learning environments enriched with dynamic visual components exhibit heightened knowledge retention. The synthesis of their study findings underscores the efficacy of multimedia-rich materials in enhancing memory recall and comprehension, thereby revolutionizing the learning experience.

As online education continues to expand, educators and instructional designers must undertake research and tactically integrate interactive visual solutions. These strategies are instrumental in fostering long-term information retention within the digital learning sphere, as illustrated in Figure 2.

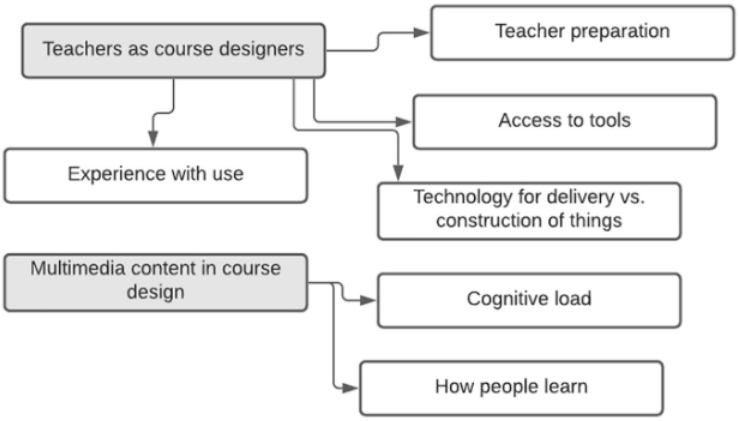


***Figure 2:*** *Knowledge Retention in Digital Learning Environment (*Johnson et al., 2023*).*

Interactive visuals enhance knowledge retention, particularly for complex concepts, by fostering stronger links between recall and comprehension. Elements such as Interactive Diagrams, Infographics, Visual Mnemonics, Mind Maps, and Concept Maps significantly contribute to student retention when utilized by educators. In fields like engineering, mathematics, and physics, visual representation of processes and connections is paramount for effective learning. Moreover, Interactive graphic components elevate student engagement, promoting active learning (Riddoch et al., 2016). Features like interactive quizzes, simulations, and virtual laboratories facilitate active learning experiences, fostering deeper cognitive processing and thereby improving long-term knowledge retention. Prioritizing accessibility in the design of interactive visuals ensures that all students, including those with disabilities, can fully engage with and benefit from the educational content (Violante & Vezzetti, 2015). Therefore, integrating interactive graphic elements into online teaching methods aligns with effective educational practices, provided that their design aligns with learning objectives.

### *Contributions of Visual Communication Design to Inclusive Learning Environments*

As the prominence of online education continues to escalate, the imperative of fostering inclusive learning environments becomes increasingly salient. In this regard, Sanger (2020) underscores the necessity of adopting a multidimensional approach, given the diverse backgrounds, learning modalities, and aptitudes of students. The integration of visual communication design holds promise in stimulating student engagement by offering information in diverse formats accessible to a broad spectrum of learners. Acknowledging the distinct requirements of students is fundamental to cultivating an inclusive environment, wherein educators should possess the capacity to impart knowledge through various modalities, with visual communication design facilitating this endeavour.

Furthermore, Bower et al. (2015) emphasize that incorporating diverse imagery into educational materials enables educators to craft comprehensive and varied learning environments. By leveraging visual elements such as photos, videos, infographics, and interactive simulations, educators can establish a rich and diversified learning milieu that enhances student engagement. Such modalities accommodate students with varying learning styles and aptitudes, thereby enabling instructional information to be disseminated effectively across multiple contexts.

Additionally, Lebenicnik et al. (2015) underscore one of the foremost benefits of visual communication design, namely, its capacity to mitigate verbal comprehension barriers. Traditional educational paradigms, which heavily rely on textual methods, may pose challenges for students at different language proficiency levels. However, visual aids

furnish a universal language for conveying ideas sans verbal communication. Photos and infographics serve to elucidate complex concepts, thereby rendering educational materials comprehensible to students from diverse cultural and linguistic backgrounds. By transcending linguistic barriers, visual communication design augments inclusivity, thereby extending instructional knowledge to a broader audience encompassing students from diverse continents and linguistic backgrounds, as depicted in the Figure 3.


**Figure 3**: *Types of Learners (*Goswami, 2020*).*

Visual communication resources accommodate various learning styles, especially crucial in online education where remote access is prevalent. Bradley (2021) notes that visuals cater to visual, auditory, and kinaesthetic learners, offering diagrams for visual learners, multimedia for auditory learners, and interactive simulations for kinaesthetic learners. This versatility allows teachers to create a classroom environment that resonates with diverse student preferences, fostering engagement and connection with the content. Interactive visual communication, as highlighted by Ahmad (2015), enhances learner engagement and inclusion, offering opportunities for active participation and personalized learning experiences. Unlike conventional passive learning approaches, interactive components and realistic virtual environments enable students to actively shape their educational journey, utilizing their unique talents and learning methods. Furthermore, the accessibility features inherent in visual communication design, as emphasized by Cober et al. (2015), facilitate inclusion by enabling the addition of subtitles, text, and editable interfaces, ensuring that students with diverse needs, including those with disabilities, can fully engage with the curriculum.

### *Theoretical Framework: Interactive Visual Communication Design in Online Education*

This research employs the theoretical frameworks of constructivism and multimodal learning to investigate the role of interactive visual communication design in facilitating online learning. The study delves into the application of these theoretical constructs to understand the dynamic functionality of this design and conducts empirical research within this conceptual framework.

### *Constructivism*

The pedagogical approach of constructivism underscores active student engagement with their knowledge and experiences as a means to foster comprehension. As posited by

Bada and Olusegun (2015), online education can effectively embody constructivist principles through the seamless integration of interactive visual communication, thereby fostering rapid knowledge acquisition. Incorporating hands-on exercises within the virtual classroom environment is imperative, as research by Mattar (2018) suggests that visual cognitive frameworks facilitate the assimilation of new content, benefiting both students and educational institutions alike. Leveraging cognitive frameworks such as constructivism enriches student learning experiences by heightening their level of interaction with the curriculum. Furthermore, the incorporation of various visual elements, including photographs and computer models, enhances understanding and fosters personalized educational experiences for learners.

*Multimodal Learning Theory*

The Multimodal Learning Theory enhances the framework by accentuating the maximization of learning outcomes through the presentation of information across various sensory modalities, as depicted in Figure 4.

In the online learning sphere, characterized by diverse learner preferences and styles, the integration of interactive visual elements becomes imperative. These considerations prompt a multimodal approach, amalgamating visual, auditory, and kinaesthetic modalities (Kustini et al., 2020), allowing learners to engage with information tailored to their individual study preferences. Visual communication design, incorporating graphics, animations, and interactive simulations, serves to accommodate a broad spectrum of sensory perceptions, thereby mitigating monotony and enhancing engagement in the learning process (Nasir et al., 2021). This approach not only caters to the diverse learning styles of learners but also harnesses the potency of multimodal learning, potentially yielding superior educational outcomes.

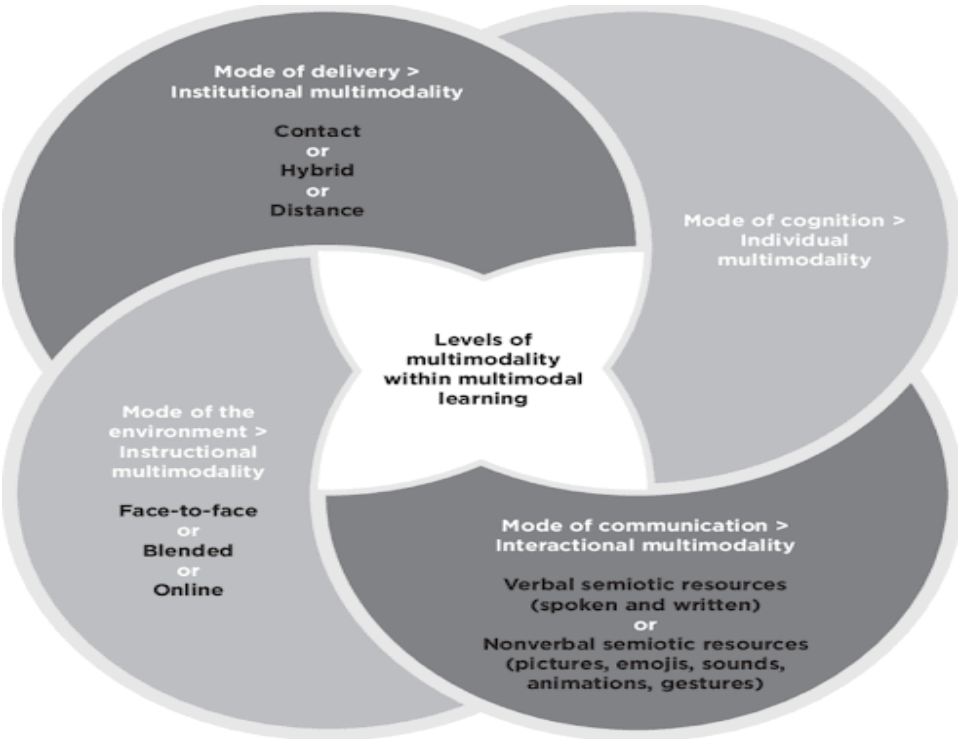


**Figure 4**: *Multimodal Learning (Anderson, 2022).*

## Hypothesis Development

This study investigates how interactive visual communication design affects online education in three key areas: student engagement, memory retention, and classroom equality. In line with the study's objectives, the following hypotheses are proposed.

### *Enhancing Student Engagement*

The hypothesis posits that online courses incorporating interactive and visual communication design elements will yield significantly higher engagement levels compared to courses employing traditional instructional design. It challenges the null hypothesis that visual factors have no bearing on student engagement in online teaching methodologies.

### *Impact on Knowledge Retention*

The research underscores the imperative of integrating interactive visual elements into online learning courses to enhance memory retention. This hypothesis contradicts the assertion that the inclusion of visual elements has negligible impact on students' retention abilities in online educational settings.

### *Contribution to Inclusive Learning Environments*

Furthermore, the study investigates the extent to which visual communication design elements contribute significantly to fostering inclusive learning environments in online education. Contrary to the presumption that these design elements have minimal impact on the inclusivity of learning environments, the hypothesis posits their crucial role in addressing the diverse needs of learners.

The literature review highlights the benefits of interactive visual communication design in online education, including improved student engagement, knowledge retention, and inclusivity. However, it also underscores the need to explore potential drawbacks and opportunities for development. There is a call for more empirical research to assess the effectiveness of various highly interactive visual components and their impact on educational institutions. Further investigations are necessary to deepen understanding of visual communication design challenges and the potential benefits of online education.

## Methodology

This chapter delineates the research methodologies employed in scrutinizing "Augmenting Learning Experiences via Interactive Visual Communication Design in Online Education." It elucidates the study methodology, search strategies, database selection, inclusion and exclusion criteria, as well as ethical considerations.

### *Research Method: Qualitative*

This study elucidates how interactive design can enhance student engagement, knowledge retention, and inclusivity in learning environments. This will be achieved through the utilization of interactive design, drawing from the outcomes of a qualitative systematic literature review. Qualitative research offers unique advantages, such as the ability to capture the richness and depth of underlying cognitive processes, behaviours, and social trends (Cypress, 2015). Hammarberg et al. (2016) have demonstrated that qualitative analysis provides more nuanced information compared to quantification, enabling researchers to discern patterns, themes, and meanings essential for deeper exploration of the subject matter. The qualitative approach is chosen for its capacity to capture the intricate perceptions and experiences of individuals using interactive visual design in online education. Unlike

quantitative inquiry, which relies on predetermined variables and metrics, this approach elicits a diverse array of in-depth narratives that illuminate the complex interaction between designs and learning outcomes. The study seeks not only to assess the effectiveness of educational design but also to understand the underlying reasons for its impact on student engagement, knowledge retention, and equity.

### *Search Strategies*

A research study's viability hinges on the robustness of its search strategies. The efficacy of search methods directly impacts the accuracy and credibility of data, thereby influencing the authenticity of the research findings. The utilization of Boolean operators and comprehensive database searches is instrumental in establishing reliability in research studies. Tricco et al. (2018) corroborate this assertion, highlighting the trustworthiness and meaningfulness of data obtained through adherence to PRISMA frameworks. The constituent elements of Boolean operators and database search algorithms are delineated below.

### *Boolean Operators*

In information retrieval, search terms employ Boolean operators to refine or broaden search queries. Cooper et al. (2018) delineate the fundamental Boolean operators as AND, which narrows results by combining phrases; OR, which broadens results by including either word; and NOT, which excludes specific words. Additionally, AND is utilized to conjoin phrases for result restriction, while OR incorporates either word for result expansion.

### *Clarification of Boolean Operators Used in Search Strategy*

Boolean operators serve as indispensable tools in database searches, facilitating the refinement and focus of search results. Their functionality is outlined as follows:

- "AND" is employed to combine search terms, ensuring that the resulting outcomes contain all the specified words. This enhances the accuracy of search results by necessitating the presence of every term in the documents.
- "OR" is utilized to incorporate any of the provided terms in the output. This operator conducts a broad search by accepting documents that contain any of the specified terms.
- "NOT" serves as the operator that filters search results by excluding specific terms. This operator aids in the identification of documents that contain terms not pertinent to the research objective.

### *Application of Boolean Operators in This Study*

- The search string "Student Engagement OR Knowledge Retention" is formulated to retrieve articles encompassing both student engagement and knowledge retention, thereby broadening the search to encompass a diverse range of research papers on various facets of online learning.
- The combination "Inclusive Learning Environments AND Online Learning" ensures the selection of documents specifically discussing inclusive learning environments within the context of online learning.
- The search string "Visual Communication Design NOT Inclusive Learning Environments" aims to exclude documents focusing on visual communication design unrelated to inclusive learning environments, thereby refining the search to more relevant materials.
- The search string "Student Engagement NOT Knowledge Retention" aims to isolate studies specifically addressing student engagement by excluding documents that primarily focus on knowledge retention.

*Databases*

The systematic review process heavily relies on databases, which serve as structured storage systems for collecting, retrieving, and managing data. In this context, databases essentially function as repositories containing scholarly articles, research papers, and literature pertinent to systematic reviews (Burda et al., 2017). Popular databases commonly utilized by research institutions include PubMed, Scopus, and WoS, which host literature across various disciplines. The ability of researchers to synthesize existing knowledge effectively is crucial, as the comprehensiveness and accessibility of these databases fundamentally underpin the entire systematic review process (Kong et al., 2020). Academic databases are organized collections of data designed for efficient storage, retrieval, and management. These databases aggregate a wide array of scholarly publications, including journals and other academic sources (Perrier et al., 2017). The Table 1 presents some of the data utilized in this investigation.

**Table 1**

*List of Databases*

| Databases |
|---|
| Google Scholar |
| IEEE Xplore |
| Science Direct |
| ERIC (Educational Resources Information Center) |
| ProQuest |
| Springer Link |
| CNKI (China National Knowledge Infrastructure) |

The choice of databases, such as Google Scholar, IEEE Xplore, Science Direct, ERIC, ProQuest, Springer Link, and CNKI, was determined by their comprehensive coverage of educational technology and availability of peer-reviewed articles. Selected for their pertinence to online learning and visual design, these databases facilitated an exhaustive literature search utilizing keywords such as 'online learning,' 'visual communication design,' and 'student engagement.' The application of Boolean operators refined the searches, ensuring a meticulous exploration of the topic and augmenting the depth and credibility of the study.

## Data Collection

The data collection process entails the identification and analysis of five (5) relevant articles obtained from reputable databases. The systematic review validates that the selected articles offer precise insights pertaining to the topic "Enhancing Learning Experiences through Interactive Visual Communication Design in Online Education.".

## Inclusion and Exclusion Criteria

Inclusion and exclusion criteria serve to establish the parameters of research by delineating the criteria for study participation, thereby enhancing the internal validity of the studies. They prove effective when meticulously outlining what is encompassed and

what is excluded from the studies, thus fostering clarity, attentiveness, and consistency in the work (Patino & Ferreira, 2018). The Table 2 illustrates the inclusion and exclusion criteria for this research.

**Table 2**

*Inclusion and Exclusion Criteria*

| *Criteria* | **Inclusion** | **Exclusion** |
|---|---|---|
| *Publication Date* | Published on or after 2010 | Published before 2010 |
| *Language* | English | Not in English |
| *Relevance to Topic* | Directly addresses the research topic | Does not show relevancy to the topic |
| *Methodology Description* | Clearly describes the research methodology | No clear methodology description |
| *Academic Integrity* | Adheres to academic integrity and citation norms | Violation of academic integrity, improper citations, or plagiarism |

The criteria for inclusion and exclusion were meticulously devised to select contemporary topics reflecting current practices in online learning and visual communication. Emphasis was placed on recent and pioneering studies, particularly from 2010 onwards, to focus on the past decade marked by significant scientific and technological advancements influencing educational methodologies. To ensure comprehensive understanding of the study findings, only English articles were considered, leveraging linguistic proficiency within the team. This criterion of topical relevance facilitated the selection of studies directly informing about the influence of interactive visual communication design on online education. Additionally, articles were required to include a description of the research methodology, thereby ensuring evaluation of their validity and reliability. Moreover, adherence to academic integrity and proper citation practices were imperative to maintain the research's reliability and ethical standards. These collective conditions support the study's endeavour to provide a thorough and reliable review of the literature on the topic.

## Prisma Framework

The primary research framework utilized is PRISMA, or Preferred Reporting Items for Systematic Reviews and Meta-Analyses. This framework elucidates the significance of systematic review and meta-analysis studies. According to Welch et al. (2016), PRISMA serves as a tool to enhance the rigor, reproducibility, and reporting accuracy of studies. Its structured process enables researchers to comprehensively and impartially evaluate findings. By contributing to the quality and credibility of systematic reviews, PRISMA facilitates the dissemination of reliable information. Moreover, PRISMA offers advantages not only to researchers but also to publishers and readers by providing clarity and consistency in the synthesis of studies (Page et al., 2021). This systematic review method adheres to the PRISMA framework, ensuring openness and methodological control. The meticulous procedure involves identifying potential papers, assessing their eligibility for study, and ultimately enhances the reliability and reproducibility of research results. Following a search across several databases using relevant keywords, 30 papers were selected for review. The PRISMA framework for this research is detailed in Figure 5.


**Figure 5**: *PRISMA Framework.*

*Ethical Considerations*

Adherence to ethical standards is fundamental to ensuring that research is conducted with honesty, transparency, and responsible conduct. Three key ethical principles governing the interaction between researchers and participants are autonomy, confidentiality, and informed consent. Ethical research practices contribute to the reliability and validity of study findings, thereby enhancing the credibility of scientific conclusions (Pietilä et al., 2020). In addition to case studies, ethical processes cultivate an environment within the research community that fosters public trust in science and upholds academic integrity. Ethical considerations are paramount at every stage of research, serving as the moral foundation of values and research outputs (Ketefian, 2015). Ethical issues in systematic reviews encompass various concerns, such as ensuring impartiality in study selection, managing conflicts of interest, safeguarding the confidentiality of sensitive data, and maintaining rigorous citation practices to prevent plagiarism. Addressing these ethical considerations through transparency and integrity is essential for bolstering the legitimacy and credibility of the review process and its outcomes.

## Results

This section presents the results obtained from the systematic literature review, elucidating noteworthy findings and constructing a model synthesized from analysed publications pertinent to "Enhancing learning experiences through interactive visual communication design in online education.".

**Table 3**

*Results and Findings*

| Title | Author | Objective | Keywords | Methodology | Findings | Year |
|---|---|---|---|---|---|---|
| Online learning and emergency remote teaching: Opportunities and challenges in emergency situations | Ferri, F., Grifoni, P., & Guzzo, T. | Explore opportunities and challenges in emergency online teaching situations | Online learning, emergency remote teaching | Qualitative research with two steps: 1) Thematic analysis of international expert online discussions; 2) Italian case study analysing data from web articles, statistics, legislation, and opinion leaders' statements. | The study reveals technological challenges (Internet reliability, device access), pedagogical challenges (digital skills, content structure, interactivity), and social challenges (human interaction, physical space, parental support) in emergency remote teaching during the COVID-19 pandemic. | 2020 |
| Effects of different video lecture types on sustained attention, emotion, cognitive load, and learning performance | Chen, C. M., & Wu, C. H. | Investigate the impact of video lecture types on attention, emotion, cognitive load, and learning performance | Video lectures, sustained attention, emotion, cognitive load | Two-factor experiment with brainwave detection, emotion sensing, and cognitive load scale. | The study reveals that lecture capture and picture-in-picture video lecture types enhance learning performance more than the voice-over type. Sustained attention varies across types. The positive and negative emotions induced by the three video lecture types do not significantly differ | 2015 |
| Attitude, digital literacy and self-efficacy: Flow-on effects for online learning behaviour | Prior, D. D., Mazanov, J., Meacheam, D., Heaslip, G., & Hanson, J. | Examine the relationships between attitude, digital literacy, self-efficacy, and online learning behaviour | Attitude, digital literacy, self-efficacy, online learning behaviour | Quantitative analysis of attitude, digital literacy, self-efficacy, and online learning behaviour. | The study identifies flow-on effects in online learning behaviour from attitude, digital literacy, and self-efficacy. | 2016 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Issues and challenges for teaching successful online courses in higher education: A literature review | Kebritchi, M., Lipschuetz, A., & Santiague, L. | Review issues and challenges in teaching successful online courses in higher education | Online courses, higher education, challenges, literature review | Conducted a literature review using Cooper's framework to synthesize prior studies on issues in online education. | Identified challenges in online education, emphasizing the need for institutional support and training for improvement. | 2017 |
| Future trends in the design strategies and technological affordances of e-learning | Gros, B., & García-Peñalvo, F. J. | Discuss future trends in design strategies and technological affordances of e-learning | E-learning, design strategies, technological affordances, future trends | Conducted a comprehensive literature review to delve into the future trends of e-learning design and technological affordances. | The review identified evolving design strategies and technological affordances in the realm of e-learning. These insights contribute significantly to the understanding and advancement of theory, research, practice, and policy within the dynamic landscape of e-learning. The synthesis of current knowledge provides valuable guidance for educators, researchers, and policymakers involved in shaping the future of e-learning methodologies and technological applications. | 2016 |

Drawing upon the findings from the aforementioned publications, this research proposes a model that integrates the outcomes and findings as shown in Figure 6.

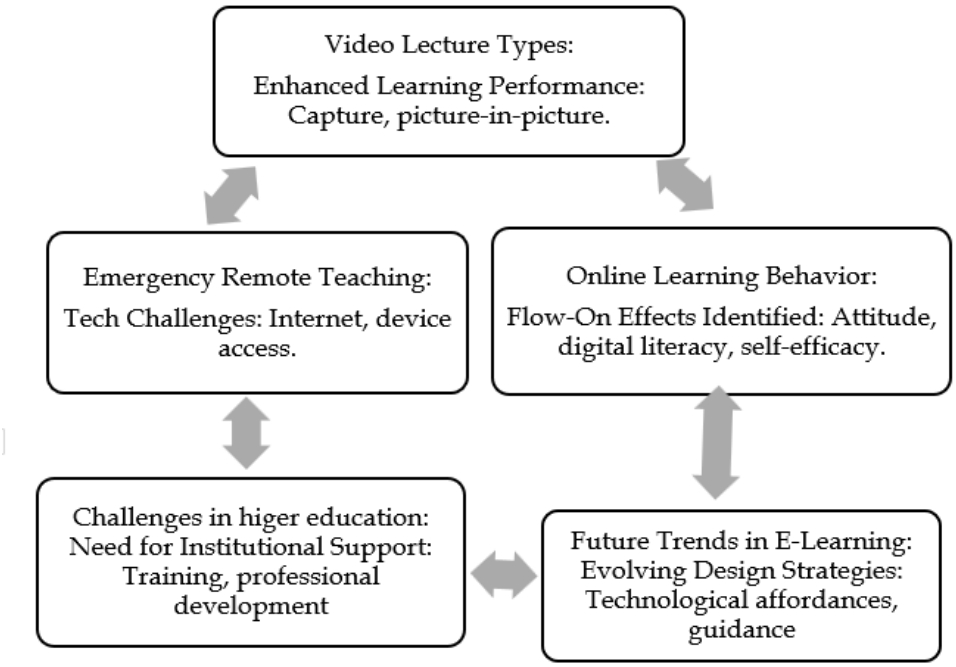


**Figure 6**: *Proposed Model.*

*Emergency Remote Teaching*

Ferri et al. (2020) investigated the challenges encountered in emergency remote teaching amid the COVID-19 outbreak. They identified technological hurdles such as unreliable internet access and insufficient electronic devices among students. These challenges underscored the imperative for viable solutions to ensure the efficacy of online education, particularly in unpredictable circumstances.

*Video Lecture Types*

Chen and Wu (2015) investigated the impact of different types of video lectures on students' learning achievement. They observed that lecture capture and picture-in-picture formats yielded superior results compared to voice-over versions. This study underscored the importance of recognizing diverse video presentation techniques that enhance engagement and performance outcomes in online education.

*Online Learning Behaviour*

Prior et al. (2016) explored the interplay between attitude, digital literacy, self-efficacy, and online learning behaviours. They identified how these psychological variables influence student behaviours in online learning, offering insights for creating favourable and productive educational experiences.

*Challenges in Higher Education*

Kebritchi et al. (2017) reviewed obstacles to teaching successful online courses in higher education, emphasizing the significance of institutional support like professional development and training. Their findings highlighted areas for improvement to enhance the quality of online education programs in higher learning institutions.

### *Future Trends in E-learning*

Gros and García-Peñalvo (2016) discussed emerging trends in e-learning design and technological opportunities. Their comprehensive literature review unveiled evolving design strategies and technological advancements crucial for educators, researchers, and policymakers shaping the future of e-learning. Their research advocated a forward-looking perspective on the potential development of e-learning approaches and technological applications.

The systematic literature review delved into key findings addressing the application of interactive visual communication design in online education to enhance learning experiences. Ferri et al. (2020) highlighted challenges in remote emergency teaching during the COVID-19 outbreak, emphasizing issues such as inconsistent internet access and inadequate electronic resources. This underscores the urgent need for sustainable adjustments in online educational services. Additionally, Chen et al. (2015) investigated the impact of different video lecture formats on learning outcomes, revealing that lecture capture and picture-in-picture formats were particularly effective in enhancing student performance. This underscores the importance of considering diverse video presentation methods to improve engagement and performance in web-based education environments.

Prior et al. (2016) identified the interplay of psychological factors such as beliefs, self-concepts, and online learning performance, shedding light on how students' experiences are shaped by these factors. Kebritchi et al. (2017) highlighted barriers to successful online teaching in higher education, emphasizing the necessity of institutional support through professional development and training. Gros et al. (2016) discussed the future of e-learning design and technological advancements, offering valuable insights for online education stakeholders. Overall, these findings align with the objectives of enhancing online education, emphasizing the importance of interactive visual communication for learning.

## Discussion

In addressing the challenges of emergency remote teaching during the COVID-19 crisis, educators and institutions encountered numerous obstacles, with technological barriers emerging as significant concerns. Ferri et al.'s investigation into emergency remote teaching further underscores the underlying complexities, advocating for comprehensive solutions. The inadequacy of reliable internet connectivity and the limited availability of electronic devices among students emerged as primary impediments to a seamless transition to online education. Ezra et al. (2021) highlighted disparities in digital access, exacerbating inequalities among students lacking adequate internet resources. Additionally, Zalat et al. (2021) noted that the scarcity of electronic devices compounded the issue, hindering some students' full participation in virtual classrooms. Recognizing the technological disparities, educational stakeholders have been prompted to explore innovative strategies and interventions aimed at fostering a more equitable learning environment. Furthermore, Müller et al. (2021) emphasized the importance of initiatives such as providing subsidized or free electronic devices and ensuring robust internet infrastructure as vital steps toward building a resilient and inclusive education system capable of withstanding unforeseen disruptions.

Chen et al. (2015) found that students exposed to lecture capture formats, where both instructor and visual aids are recorded simultaneously, demonstrated significantly better learning outcomes. This unified presentation method enhances comprehension and engagement by connecting students visually to their instructor and instructional content. However, voice-over versions with audio commentary showed reduced efficacy. Choe et al. (2019) suggested that the effectiveness of picture-in-picture mode may stem from increased teacher-student interaction and visual content overlap, fostering a sense of

connectedness and motivation. Conversely, Smallhorn (2017) observed that voice-over formats' limited effectiveness highlights comprehension challenges without visual cues, potentially hindering students' understanding and focus.

Understanding the influence of attitude on digital literacy and self-efficacy is crucial for enhancing student performance in e-learning. Prior et al. (2016) underscored the significance of this relationship, highlighting its dynamic nature and multifaceted impact on online education outcomes. Panigrahi et al. (2018) further emphasized the pivotal role of attitude in fostering student commitment to online learning, suggesting that a positive attitude initiates proactive engagement and facilitates greater achievement. Additionally, Chen et al. (2023) revealed a positive correlation between digital literacy and the adoption of various online tools and applications, underscoring the importance of digital skills in navigating digital environments effectively. Moreover, high self-efficacy fosters resilience and persistence, enhancing academic performance and sustained engagement, as noted by Deja et al. (2021). This complex interplay among attitude, digital literacy, and self-efficacy shapes students' online learning behaviours and influences their perceptions and responses to digital elements within educational contexts.

Identifying barriers that hinder the quality of distance education remains crucial in higher education institutions' online learning environments. Institutional support emerges as a significant concern, as highlighted in the literature review by Kebritchi et al. (2017). Effective online teaching necessitates structured professional development and training for educators, equipping them with the requisite skills to navigate diverse online platforms, engage with students in virtual environments, and employ innovative pedagogical approaches. Similarly, Adekola et al. (2017) underscored the detrimental impact of inadequate funding for professional development and training on instructors' ability to effectively utilize available online teaching methodologies, thereby compromising the quality of educational content delivery. Furthermore, Willcox et al. (2016) emphasized the importance of focusing on specific areas for improvement in online courses, such as designing accessible courses and seamlessly integrating technology, along with implementing effective methods for evaluating student performance in virtual settings. Institutions that address these concerns proactively are more likely to achieve favourable outcomes in their e-learning endeavours.

Exploration of new design principles and technological advancements in e-learning illustrates the evolving landscape of educational methodologies and technological applications. Gros et al. (2016) underscore the pivotal roles played by educators, specialized researchers, and policymakers in driving e-learning innovations, emphasizing the need for a comprehensive understanding of these rapidly changing dynamics to enhance people's lives through online technology. Furthermore, Northcote et al. (2015) highlight the integration of artificial intelligence in these technologies, enabling personalized learning experiences tailored to individual student needs in online classes. Additionally, technological advancements such as Virtual and Augmented Reality are revolutionizing the e-learning environment by providing immersive learning experiences. May et al. (2023) elucidate how virtual laboratories and augmented reality applications facilitate hands-on learning, enabling students to bridge theoretical knowledge with practical application.

## Conclusion

In conclusion, this paper examines the impact of interactive visual communication design on online learning, focusing on its role in enhancing student experiences. As traditional classrooms shift to virtual spaces, the challenges of creating engaging and effective learning environments become apparent. Through various interactive visual elements like graphics, animations, and simulations, online education can bridge this gap and offer a visually appealing and stimulating experience. This review emphasizes the

limitations of traditional textual presentations in online learning and highlights the effectiveness of multimedia-rich content in improving memory recall and comprehension. Integrating elements such as charts, diagrams, infographics, and visual mnemonics proves particularly beneficial in fields like engineering, mathematics, and physics, where visualization plays a crucial role in understanding complex concepts. In addition to this, Visual communication design plays a pivotal role in fostering inclusive learning environments, as emphasized in literature. Theoretical frameworks like constructivism and multimodal learning theory underpin the study of interactive visual communication design in online education. Constructivism's focus on student activity aligns with the immersive nature of visual cognitive models, while multimodal learning theory advocates for utilizing diverse sensory modalities for optimal learning outcomes. These frameworks provide a conceptual lens for understanding the interaction in visual elements. Research objectives and hypotheses guide a systematic review exploring the impact of interactive visual communication design on student engagement, knowledge retention, and inclusivity. Adhering to the PRISMA framework, the literature review selects relevant articles to synthesize knowledge in this domain. Overall, this research contributes to enhancing digital education practices by advocating for the effective integration of interactive visual communication design in online learning environments.

## Implications

The study's implications are delineated as follows:

### Educational Paradigm Shift

The results advocate for a departure from traditional instructional methods towards embracing the dynamic realm of interactive visual communication design among educators and instructional designers. Incorporating visual elements such as graphics, animations, simulations, and virtual reality (VR) fosters engagement and facilitates immersive learning experiences in virtual environments.

### Strategic Integration for Deeper Understanding

This research aims to investigate the enhancement of memory recall in online learning through visual stimuli. It delves into visual elements as potential solutions to address cognitive challenges. Educators require proficiency in utilizing infographics, diagrams, and mnemonic imagery to facilitate comprehension of intricate subjects. To attain this objective, professional development programs should equip teachers with the necessary skills and knowledge in teaching visual communication design online.

### Inclusive Learning Environments

The study underscores the role of visual communication design in fostering inclusive learning environments. It advocates for the adoption of multimodal strategies to accommodate diverse backgrounds and learning needs of online students. Policymakers are urged to invest in accessible visual aids to promote equitable educational opportunities for all learners.

### Implications for Educational Technology

Beyond traditional classrooms, the integration of interactive elements has broader implications for ongoing conversations surrounding online education. These elements facilitate a seamless transition into emerging trends in educational technology, particularly immersive technologies like virtual and augmented reality. It is essential for stakeholders to stay updated on technological advancements and adequately prepare educators to navigate the dynamic landscape of distance education.

### Proactive Redefinition of Practices

The research recommends a proactive overhaul of online learning methodologies, emphasizing the pivotal role of interactive visual communication design in enhancing quality, inclusivity, and engagement in digital learning platforms. The insights gleaned from this study serve as a roadmap for stakeholders aiming to harness the potential of visual communication design to shape the future of education.

## Recommendations

The realm of interactive visual communication design within online education provides valuable insights for educators, instructional designers, policymakers, and stakeholders invested in enhancing digital learning environments. Drawing from the study, several recommendations have surfaced, offering actionable guidance to inform future practices and initiatives.

### Professional Development Initiatives

To cultivate proficiency in visual communication design, educators and instructional designers should engage in diverse professional development initiatives. Workshops, training sessions, and available resources aimed at fostering interactive elements in online courses can empower educators to craft more engaging learning experiences.

### Institutional Support for Technological Integration

In the modern landscape, educational institutions must facilitate the integration of emerging technologies like virtual reality and augmented reality into online education. This entails investing in infrastructure, resources, and training to enable educators to seamlessly incorporate these technologies into their instructional practices, thereby enhancing the quality of online learning.

### Collaboration and Knowledge Sharing

Facilitating collaboration and knowledge exchange among educators, instructional designers, and researchers in the domain of online education is essential. Establishing platforms for sharing best practices, case studies, and successful methodologies related to interactive visual communication design within the community can foster a collective understanding of effective strategies that evolve iteratively over time.

### Accessibility and Inclusivity Considerations

Create visual elements with broad accessibility, catering to diverse student needs and learning profiles, including those with disabilities. Educational technology developers and designers must adhere to universal design principles, integrating features such as alt text captions, subtitles, and personalized user options.

### Research on Pedagogical Impact

Encourage further research into pedagogical outcomes associated with specific visual elements and interactive technologies in online learning. Through thorough analyses, particularly focusing on virtual reality simulations, interactive infographics, and other design elements, educators can consistently determine which tools align best with their pedagogical objectives.

### Adaptability to Diverse Learning Styles

Recognize and cater to diverse learning styles through the integration of visual

elements appealing to various sensory modalities. Furthermore, when designing interactive visual communication, take into account the requirements of visual, auditory, and kinaesthetic learners, thereby embracing a broad range of learning styles to foster inclusive educational opportunities.

## Integration of Constructivist and Multimodal Learning Theories

Educators should adopt the principles of constructivist and multimodal learning theories, which emphasize student-centred approaches and the use of multiple sensory modalities in information presentation. By doing so, educators can effectively implement interactive visual communication design to facilitate meaningful learning experiences.

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