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# Constructivism in Online and Hybrid Learning Before and After COVID-19: A Systematic Literature Review

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**ABSTRACT**

**Purpose –** Accelerated by the COVID-19 epidemic, the move to online and hybrid learning settings has underlined the need for constructivist ideas in contemporary education. Digital education methods fit well with constructivism, which stresses active, student-centred learning via interaction and teamwork. This study explores the evolving application of constructivism in online and hybrid learning environments before and after the pandemic, identifying key opportunities, challenges, and factors influencing its effectiveness.

**Methodology –** Covering 2016 to 2024, the article used a Systematic Literature Review (SLR) methodology using the Kitchenham technique. Literature selection guided by the PICOC framework, Boolean search techniques, and quality evaluations led to 69 chosen papers, including three primary phases: planning, execution, and reporting.

**Findings –** The study discovered that online education employing Learning Management Systems (LMS), virtual reality (VR), and collaborative technologies has progressively integrated constructivism. These technologies enable peer cooperation, inquiry-based learning, and problem-based learning. The study revealed continuous problems despite these advances, including technological challenges, instructor readiness, and student participation. The efficacy of the constructivist method was strongly affected by social and technical factors like access to technology and collaboration dynamics.

**Contribution –** The research provides an insightful analysis of how constructivism changes to fit the evolving educational environment. It gives teachers, legislators, and technology creators strategic ideas to create engaging, efficient, and inclusive digital-era learning environments.

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## INTRODUCTION

The digital transformation in education has accelerated extraordinarily since the onset of the COVID-19 pandemic in early 2020. This global crisis forced educational institutions around the world to make a sudden shift from face-to-face instruction to online and hybrid learning models. This transition disrupted learning continuity and exposed structural weaknesses in the readiness of education systems for digitalization (Bartusevičienė et al., 2021; Yun, 2023). Within this context, an urgent need emerged for pedagogical approaches that adapt to the digital learning ecosystem. One approach that has regained attention is constructivism, which philosophically emphasizes the importance of active, reflective, collaborative, and experience-based learning (Shah et al., 2024).

Constructivism has become increasingly relevant in the digital era as it places students at the center of the learning process. This approach encourages learners to construct knowledge through social interaction, self-directed inquiry, and problem-solving in meaningful contexts. The integration of technologies such as Learning Management Systems (LMS), Virtual Reality (VR), Artificial Intelligence (AI), and collaborative platforms has opened vast opportunities to implement constructivist principles in blended and fully online learning environments (Dritsas & Trigka, 2025; Xu et al., 2024). LMS platforms have evolved beyond content distribution tools to become reflective spaces enabling meaningful interactions between students, content, and instructors (Archambault et al., 2022). VR technologies even allow the creation of contextual and authentic simulations aligned with Vygotsky's Zone of Proximal Development (ZPD) principle (Rigopouli et al., 2025).

However, the implementation of constructivism in digital environments faces fundamental challenges. These include disparities in access to devices and internet connectivity, low levels of digital literacy, and limited teacher competencies in facilitating technology-based learning—factors that threaten the inclusivity and effectiveness of education (Bordoloi et al., 2021; Mittal & Alavi, 2020). Many schools, especially in developing countries, have yet to successfully transition the teacher's role from information provider to reflective learning facilitator. Furthermore, low student engagement in online learning is often linked to instructional designs misaligned with constructivist principles. This has created a pedagogical gap that calls for more adaptive, inclusive, and contextual approaches.

Several previous studies have explored the contributions of constructivism in digital learning contexts. Ntim et al. (2021) found that post-pandemic blended learning demonstrated higher effectiveness through collaboration and independent learning. Nurwidodo et al. (2023) explored online learning in the sciences, while Sukiman et al. (2022) examined the implementation of Islamic education in hybrid models. Funa & Talaue (2024) focused on using Metaverse technology, and Adigun et al. (2024) emphasized the importance of self-directed learning as a core component of constructivism. Nevertheless, these studies generally have limited scope regarding educational level, field of study, and technological spectrum. Moreover, most are fragmented and do not provide a comprehensive temporal analysis of the development of constructivism in digital learning from pre- to post-pandemic periods.

This gap forms the foundation of this study's argument and positioning. To date, no systematic review presents a longitudinal synthesis of the evolution of constructivist implementation in online and hybrid learning across a broad period and within a multidisciplinary context. In addition, previous research has not explicitly linked constructivist approaches to the effectiveness of advanced technology-based digital learning (AI, VR, interactive LMS), particularly within the framework of deep learning pedagogy that encompasses cross-contextual conceptual understanding, critical thinking, and reflection.

Therefore, this study aims to (1) examine the development and implementation of constructivist approaches in online and hybrid learning from the period before to after the COVID-19 pandemic; (2) identify sociotechnical opportunities and challenges in implementing this approach, particularly in higher education; and (3) analyze the relationship between constructivist approaches and the effectiveness of digital learning through deep learning principles. To support these objectives, the study adopts a systematic approach by analyzing literature from 2016 to 2024, complemented by thematic mapping using VOSviewer to identify conceptual interrelations such as e-learning, student engagement, pedagogy, and digital technology.

This study's main contribution lies in its temporal and multidimensional analysis of the development of constructivist approaches in digital learning. This research offers a literature mapping and a comparative synthesis across educational levels and technological spectrums, which remains underexplored in prior studies. Additionally, using deep learning pedagogy as an analytical framework provides an added dimension in evaluating the effectiveness of constructivist-based learning.

The findings of this study can serve as a foundation for policymakers, curriculum developers, educators, and educational technology developers in designing more adaptive and responsive digital learning environments that meet the needs of 21st-century learners. This study recommends the design of LMS platforms that go beyond administrative functions to support reflection, collaboration, and personalized learning. Furthermore, the study's findings are essential in shaping teacher training strategies and improving digital literacy for both educators and students. Constructivism remains a vital foundation in creating humanistic, reflective, collaborative, and meaningful learning experiences in the constantly evolving post-pandemic era.

## METHODOLOGY

This study employed a Systematic Literature Review (SLR) approach based on the Kitchenham method (2009), which consisted of three main stages: planning, conducting, and reporting. The primary objective was to evaluate the development of constructivist approaches in online and hybrid learning in higher education before and after the COVID-19 pandemic.

### PICOC Framework

The formulation of research questions refers to the PICOC framework to ensure alignment between the study focus, search strategy, and analysis.

**Table 1.** PICOC Structure

| | |
|---|---|
| Population | Constructivism, Student, Teacher, Online Learning, Hybrid Learning |
| Interventation | Constructivism Strategy, Learning Strategy, Learning Online Strategy, Hybrid Learning Strategy |
| Comparison | Online Learning Strategy, Hybrid Learning Strategy |
| Outcome | Enablers, Barriers, and Effective Strategies in Learning Techniques, |
| Context | Constructivism, Student, Teacher, Online Learning, Hybrid Learning |

### Search Strategy and Boolean String

The Boolean string was designed more specifically to ensure relevance to the focus on constructivism:

**Table 2.** Boolean Search

| Boolean String |
|---|
| ("constructivism" OR "constructivist approach" OR "social constructivism") AND ("online learning" OR "e-learning" OR "blended learning" OR "hybrid learning") AND ("learning strategy" OR "pedagogical design" OR "instructional design" OR "collaborative learning" OR "student engagement") AND ("higher education" OR "college" OR "university") |

### Inclusion and Exclusion Criteria

A step-by-step selection process was carried out based on inclusion and exclusion criteria to ensure the relevance and quality of the articles analyzed in this study. The following table summarizes the selection stages and the criteria used at each stage.

**Table 3.** Inclusion and Exclusion Criteria

| Stage | Inclusion Criteria | Exclusion Criteria |
|---|---|---|
| Initiation Stage | Matches the search keywords<br>Written in English<br>Published between 2016 and August 2024 | Written in languages other than English<br>Published outside the 2016–August 2024 range |
| Stage 1 (Title and Abstract Screening) | Contains components of Constructivist Learning<br>Online Learning<br>Hybrid Learning<br>Enablers and barriers | Does not include components of constructivism<br>Non-academic sector<br>Duplicate papers |
| Stage 2 (Full-Text Screening) | Discusses the implementation of Constructivist Learning in Online and Hybrid Learning Environments<br>Open-access papers | Does not discuss the implementation of Constructivist Learning in Online and Hybrid Learning Environments<br>Full-text not accessible |

**Selection Process and Quality Assessment**

From an initial total of 5,583 articles, a screening process based on titles and abstracts resulted in 220 articles. After full-text review and quality assessment, 69 final articles were selected. Each literature article was scored using a binary scale of 0 or 1, where 0 indicated disqualified literature and 1 indicated highly eligible literature. Eight checklist items were established in this final assessment system, with a quality threshold score set at 0.8. The quality assessment is explained as follows:

**Table 4.** Quality Test Question Checklist Table

| Checklist | Question |
|---|---|
| C1 | Does the article clearly describe the research objectives? |
| C2 | Does the article include the literature review, background, and research context? |
| C3 | Does the article present related work from previous research to show the main contribution of the research? |
| C4 | Does the article describe the proposed architecture or methodology? |
| C5 | Does the article have research results? |
| C6 | Does the article present conclusions relevant to the research objectives or problems? |
| C7 | Does the article recommend future work or improvements? |
| C8 | Indexed (Q1, Q2, Q3, Q4 or unindexed) |

Two independent reviewers also conducted the selection process, and inter-rater reliability was tested using Cohen's Kappa.

$$\kappa = \frac{\Pr(a) - \Pr(e)}{1 - \Pr(e)},$$

(Parlika et al., 2022)
Pr(a) = The percentage of consistent ratings between raters
Pr(e) = The percentage of expected agreement by chance

In the inter-rater reliability analysis using Cohen's Kappa on data with entirely consistent values (all 1–1), a κ value of 1 was obtained, which falls into the "outstanding" category.

**Publication Quality Analysis**

The distribution of articles based on journal ranking and Impact Factor showed that, out of the total 69 reviewed articles, the majority were published in Q1-ranked journals, with 30 articles reflecting a strong tendency of authors to reference highly reputable journals with Impact Factors (IF) ranging from 1.5 to 19.1.

Q2 journals contributed 14 articles with IFs between 1.3 and 4.614, indicating good quality, though slightly below Q1. Five articles were published in Q3 journals with more moderate IFs, and only 1 article appeared in a Q4 journal. Meanwhile, 19 other articles were published in unindexed sources or lacked available Impact Factor information. This distribution illustrated a dominant focus on high-reputation references in this study.

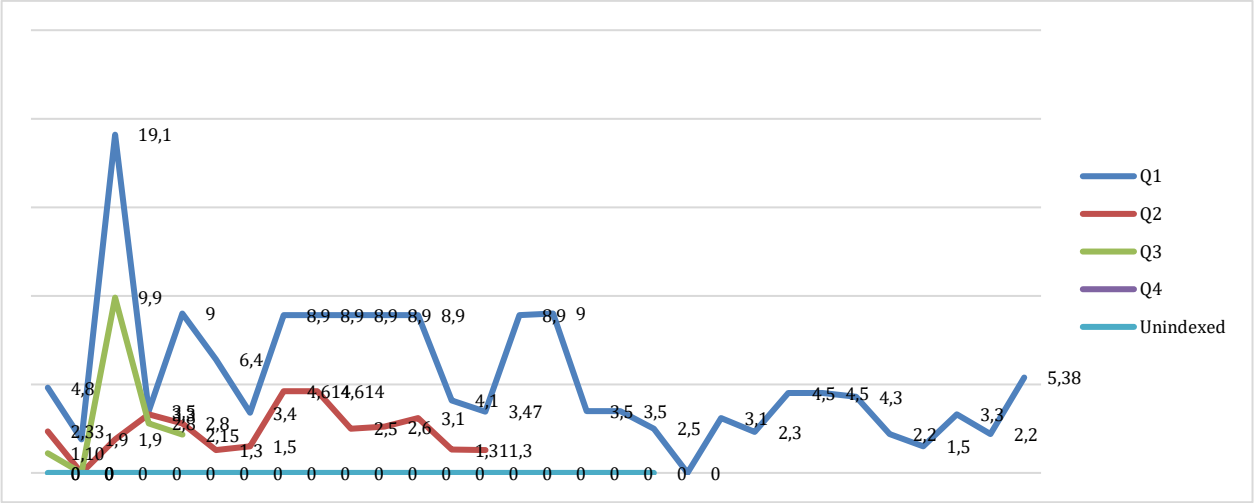


**Figure 1.** Distribution of Articles Based on Journal Ranking and Impact Factor

Furthermore, the United States dominated the geographical distribution of publications, followed by China and India. At the same time, the "Other" category included contributions from more than 20 countries, indicating a diverse range of study contexts and broad global representation (Table 7). In terms of database sources, most articles were retrieved from ProQuest (19 articles) and Scopus (20 articles), two leading databases known for their reputable journal coverage and rigorous selection criteria, thereby enhancing the validity and relevance of the literature analyzed in this study (Table 5).

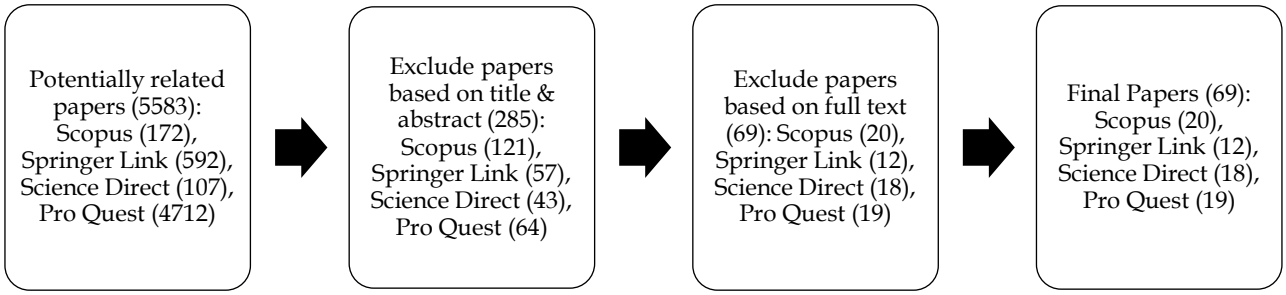


**Figure 2.** Paper Selection Process

Based on the research conducted, out of 5,583 initial articles retrieved from four major databases (Scopus, SpringerLink, ScienceDirect, and ProQuest), only 69 (1.2%) successfully passed the final selection stage. This high dropout rate resulted from a multi-layered selection process systematically designed to ensure topic relevance, methodological quality, and full-text accessibility. The selection was done in two main stages—screening based on titles and abstracts, and full-text evaluation—using criteria aligned with the PICOC framework and article quality assessment. Thus, the high dropout rate reflected an effort to maintain validity, methodological consistency, and the scientific contribution of the analyzed literature, rather than being merely the result of overly narrow or inappropriate criteria. This approach emphasized the importance of rigorous selection to produce a reliable and accountable literature synthesis.

## FINDINGS

### Literature Review Results

As previously mentioned, 69 articles were selected as sources for the literature review. Based on the year

of publication, the highest number of articles was published in 2021. The United States was identified as the country with the most journal publications; the most significant sources came from the Scopus database. Further details are as follows:

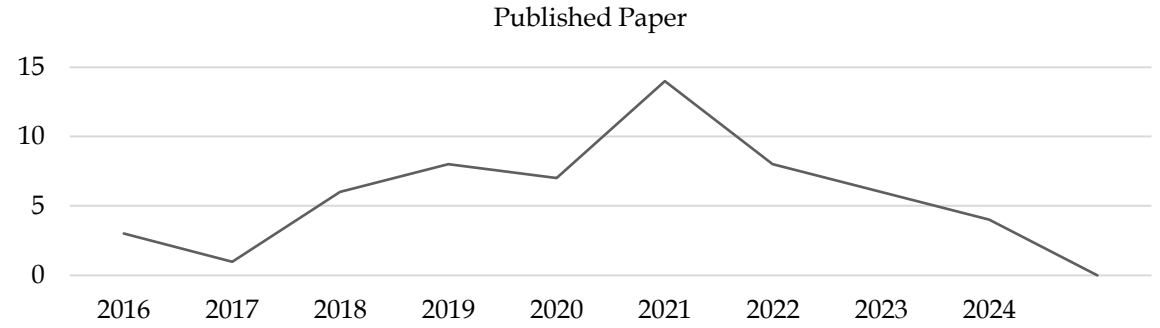


**Figure 3.** Published Paper

Sixty-nine relevant papers were found for analysis in this research, depending on the findings of a literature search across many database sources. Selected for their reputation and wide coverage of scientific publications, four central databases—Scopus, ScienceDirect, SpringerLink, and ProQuest—were used to compile these papers. The detailed number of articles from each database is presented in Table 5 below:

**Table 5.** Source Database

| Year | Paper |
|---|---|
| Scopus | 20 |
| Science Direct | 18 |
| SpringerLink | 12 |
| ProQuest | 19 |
| Total | 69 |

Article distribution by nation reveals that most come from the United States, with China and India next. This underlines the predominance of these nations in supporting research in the relevant sector. However, the rest of the papers originate from many nations and include much more. The details of the number of articles by country of origin are presented in Table 6 below:

**Table 6.** Source Country

| Country | Paper |
|---|---|
| United State | 13 |
| China | 6 |
| India | 5 |
| Other | 45 |
| Total | 69 |

Next, an analysis was conducted on the data obtained through the extraction process from the selected articles. The distribution of articles based on the authors' countries of origin showed that the most significant contribution came from the United States with 13 articles, followed by China with six articles. Australia and India each contributed five articles. Greece accounted for four articles, while countries such as Saudi Arabia and Iran also demonstrated a relatively high level of participation, each with three articles. Meanwhile, countries like Indonesia, Malaysia, Israel, and Spain made moderate contributions, each with two articles. Other countries, including Serbia, New Zealand, Belgium, Cyprus, Estonia, France, Hungary, Ireland, Kenya, Mexico, Taiwan, Thailand, and the United Kingdom, contributed only 1 article each. This distribution indicates a dominance of developed countries in scientific publications on the topic under review, with limited participation from developing nations.

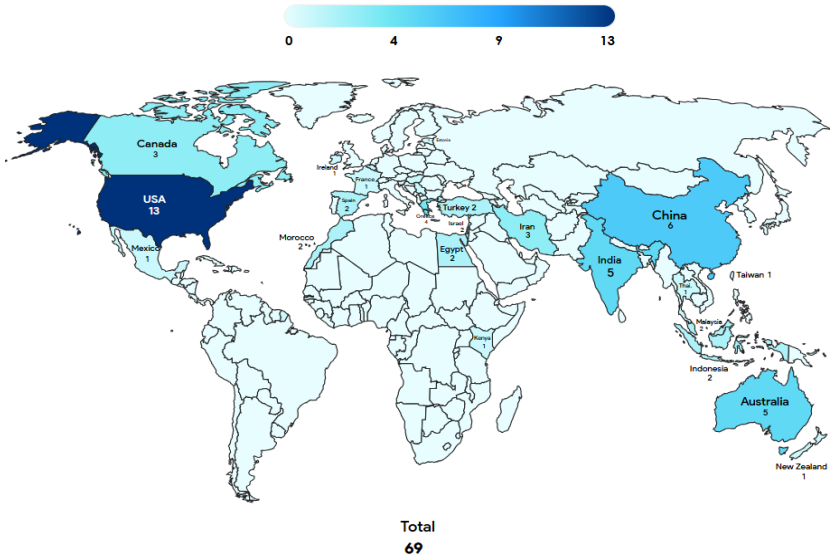


**Figure 4.** Geographical Distribution Map of Articles by Country of Origin

**Data Extraction**

The data extraction in this study is presented in a tabular format containing the core information from each analyzed article. Each entry includes the author's name and year of publication, paper title, primary focus of the study (about), challenges encountered (challenge), and the strategies used (strategy used). This approach offers readers a thorough and organized summary of the material and contributions of every article to the study subject, guiding the analytical process. Attachment 1 presents the extracted data based on the viewpoint of each article.

**Data Visualization**

Particularly in the context of constructivism and higher education, the VOS visualization emphasizes the relevance of these ideas by showing a complicated web of related terminology centered on e-learning, blended learning, and online learning. "E-learning," which links to important concepts like "blended learning," "constructivism," and "pedagogy," is at the core of the network. This centrality emphasizes the need for e-learning as a basis for bringing technology-based ideas within the educational framework.

The network visualization in Figure 5 reflects the complexity and dynamics of constructivism's development in the context of online and hybrid learning, particularly before and after the COVID-19 pandemic. A deeper interpretation of this network reveals several major interrelated clusters:

First, "e-learning" emerges as a central node connecting various pedagogical and technological concepts such as "constructivism," "pedagogy," "learning systems," "blended learning," and "students." This indicates that e-learning has become a foundational platform for implementing constructivism in the digital era. The proximity of e-learning to "constructivism" and "pedagogy" reinforces the argument that digital transformation in education is not merely about adopting technology, but also about a paradigm shift toward more participatory and reflective pedagogical approaches.

Second, the "blended learning" and "online learning" clusters overlap with terms like "collaborative learning," "distance education," and "learner engagement." This suggests that the effectiveness of digital learning is highly dependent on the synergy between synchronous and asynchronous methods, as well as active learner engagement. The dominance of keywords such as "community of inquiry" and "inquiry-based learning" indicates the importance of social interaction and independent exploration as the foundation of meaningful learning within a constructivist framework.

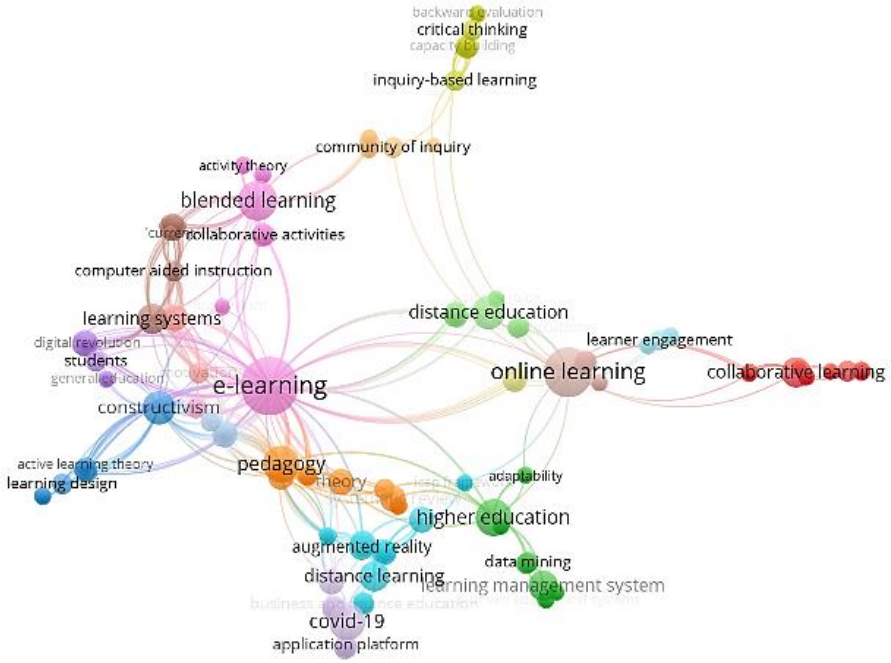


**Figure 5.** VOS Visualization Keyword

Third, the green and brown clusters—comprising terms such as "higher education," "distance education," and "learning management system"—reflect the contextual focus of constructivist implementation in tertiary education. Strong links with terms like "adaptability," "data mining," and "application platform" suggest institutional adaptation to demands for flexibility and the use of technology-based educational analytics.

Fourth, the impact of the COVID-19 pandemic is visible through the linkage of the term "COVID-19" with concepts such as "augmented reality" and "application platform." This indicates that the pandemic accelerated digitalization and encouraged pedagogical experimentation with immersive technologies that had not previously been widely adopted. This cluster demonstrates how global pressures spurred innovation and broadened the adoption of constructivist-based learning models.

Finally, the isolated yet thematically connected red cluster around "collaborative learning" and "learner engagement" highlights the importance of social interaction and teamwork in fostering authentic engagement. The reliance on collaborative activities suggests that without strong collaborative strategies, the effectiveness of constructivist e-learning would diminish.

This visualization represents a conceptual structure that mutually reinforces the interconnections between technology, learning theory, and institutional contexts. These interrelated patterns emphasize that constructivism is not merely a pedagogical approach but an adaptive framework that continues to evolve alongside technological advances and social dynamics, especially when addressing global challenges such as the pandemic.

Thus, based on the keyword network visualization generated from 69 articles, it is evident that there is a centralizing trend around e-learning, which acts as the central hub and is most connected to various other concepts. Keywords such as blended learning, constructivism, learning systems, and pedagogy form dominant clusters that demonstrate how constructivist approaches and learning systems are fundamental to the discourse on e-learning. Meanwhile, online learning and distance education create their clusters, highlighting their relevance to learner engagement, higher education, and collaborative learning. Additionally, topics like inquiry-based learning, critical thinking, and community of inquiry appear in more specific groups, focusing on participatory approaches and developing 21st-century skills. This pattern

suggests that in pre- and post-COVID-19 contexts, the integration between technology, constructivist approaches, and the need for active student engagement, especially in remote and online learning environments, has strengthened.

**Constructivist Implementation: Before and After COVID-19**

In keeping with changes in educational modalities and the requirement for flexibility in online and hybrid learning settings, constructivism—a pedagogical approach—underwent a significant evolution before and during the COVID-19 epidemic. Before the pandemic, traditional classroom settings often used constructivist implementation, wherein instructors directed active and cooperative learning experiences via direct touch. In this context, face-to-face discussions, group projects, and practice-based projects, all supported by a physical environment conducive to collaboration, gained center stage in promoting critical thinking and knowledge development (Boughalem & Khaldi, 2019). Conversely, the pandemic overturned these traditional approaches and pushed a rapid move to hybrid and online learning. This adjustment demonstrated constructivist thinking's durability and adaptability. Throughout the pandemic, schools and teachers used digital technology to mimic cooperative learning activities in virtual spaces. Strategies encourage student autonomy and participation under physical distance, thus project-based learning, asynchronous discussions, and flipped classes become more important. Implementing constructivist ideas in digital environments was greatly aided by platforms like collaborative software, video conferencing tools, and Learning Management Systems (LMS) (Hamutoğlu et al., 2024; Luca et al., 2021; Zarzycka et al., 2021).

**Table 6.** Comparison of Constructivist Implementation Before and After COVID-19

| Aspect | Before Covid-19 | After Covid-19 | References |
|---|---|---|---|
| Learning Environment | Primarily face-to-face in physical classrooms. | Online and hybrid learning environments. | (Boughalem & Khaldi, 2019; Epaminonda et al., 2022; Hamutoğlu et al., 2024; Innes & Hawryluk, 2023; Monk et al., 2020; Yan, 2022) |
| Interaction Style | Direct, in-person interactions between students and teachers. | Virtual interactions through video calls, discussion forums, and chat tools. | (Cross, 2021; Janelli, 2018; Joseph & Joy, 2019; Luca et al., 2021; Zarzycka et al., 2021) |
| Technology Usage | Minimal reliance on technology; often limited to supplemental tools. | Heavy reliance on digital platforms, learning management systems, and apps. | (Caldwell et al., 2021; Hamutoğlu et al., 2024; Kumar & Sharma, 2021; Mittal & Alavi, 2020; Mohammed & Kinyó, 2022; Shoaib et al., 2024; Zarzycka et al., 2021) |
| Collaboration | Group work and discussions are held in person. | Collaborative projects are conducted using online tools like Google Docs and Slack. | (Collins et al., 2018; Hamutoğlu et al., 2024; Luca et al., 2021; Stafford, 2022; Wise & Cui, 2018; Yan, 2022) |
| Student Engagement | Facilitated through physical activities, hands-on projects, and class discussions. | Maintained through interactive tools, gamification, and online assessments. | (Bardone et al., 2024; Capone, 2022; Fang et al., 2023; Hamutoğlu et al., 2024; Ünlü et al., 2023; Wang et al., 2024; Zarzycka et al., 2021) |
| Teacher's Role | Facilitator of in-person discussions and activities. | Moderator and designer of digital learning experiences. | (Ament & Edwards, 2018; Archambault et al., 2022; Hamutoğlu et al., 2024; Luca et al., 2021; Wilson & Berge, 2023) |

| Aspect | Before Covid-19 | After Covid-19 | References |
|---|---|---|---|
| Accessibility | Physical presence is required; accessibility is limited to classroom resources. | Increased flexibility, but dependent on technology access and the internet. | (Caldwell et al., 2021; Epaminonda et al., 2022; Koukopoulos & Koukopoulos, 2019; Luca et al., 2021; Shoaib et al., 2024; Younis et al., 2021; Zarzycka et al., 2021) |
| Assessment Methods | Traditional exams, quizzes, and physical project submissions. | Online quizzes, virtual presentations, and digital project submissions. | (Atapattu et al., 2019; Cadet, 2023; Callaghan & Collins, 2021; Janelli, 2018; Wang et al., 2024) |
| Adaptability | Standardized; less emphasis on individualized learning paths. | Enhanced flexibility with personalized and adaptive learning technologies. | (Aderibigbe, 2021; Alt, 2025; Bashir, 2019; Hamutoğlu et al., 2024; Labrović et al., 2025; Zarzycka et al., 2021)(Luca et al., 2021) |
| Challenges | Classroom management, resource constraints. | Digital divide, maintaining engagement, and technical issues. | (Hamutoğlu et al., 2024; Huang & Lajoie, 2023; Luca et al., 2021; Nagar & Maskit, 2016; Qiu, 2019; Safarifard et al., 2024; Srivastava & Prabhakar, 2020; Zarzycka et al., 2021) |

Although the pandemic has transformed the use of technology and methodologies in education, the core principles of constructivism—such as collaboration, reflection, and student-centered learning—have remained consistent. The following aspects of constructivist implementation did not undergo significant changes before and after the COVID-19 pandemic.

**Table 7.** Key Aspects in the Constructivist Approach

| Aspect | Explanation | References |
|---|---|---|
| Focus on Student-Centered Learning | The constructivist approach consistently places students at the center of the learning process, emphasizing active participation and independent understanding. | (Archambault et al., 2022; Capone, 2022; Cross, 2021; Elfeky et al., 2020; ElSayad, 2023; Fang et al., 2023; Howe et al., 2018; Stafford, 2022) |
| Collaboration as a Core Element | Collaboration among students remains a critical component, even though the medium has shifted from physical to digital. The goal of fostering social learning persists. | (Atapattu et al., 2019; Huang & Lajoie, 2023; Lawrie et al., 2016; Nagar & Maskit, 2016; Qiu, 2019; Stafford, 2022; Wise & Cui, 2018; Zarzycka et al., 2021) |
| Role of Reflection | Reflection continues to be an integral part of the learning process, enabling students to evaluate and connect their learning experiences. | (Collins et al., 2018; Innes & Hawryluk, 2023; Janelli, 2018; Kumar & Sharma, 2021; Safarifard et al., 2024; Shaver, 2017) |
| Use of Constructivist Frameworks | Vygotsky's Zone of Proximal Development theory and experiential learning techniques are central to constructivist practices in various contexts. | (Hamutoğlu et al., 2024; Lawrie et al., 2016; Luca et al., 2021) |
| Contextual Learning Goals | Learning is constantly meant to be pertinent to reality. Therefore, it helps students close the gap between theory and practice. | (Aljohani & Aljehani, 2024; Ament & Edwards, 2018; Andina et al., 2019; Atapattu et al., 2019; Bashir, 2019; Capone, 2022; Epaminonda et al., 2022; |

Junaid & Sigala, 2024; Ouahi et al., 2021; Pourdana, 2022)

Constructivism has evolved in the post-pandemic era by incorporating insights gained during the pandemic. The current paradigm of hybrid learning offers flexible and personalized learning experiences by combining the benefits of face-to-face and online education. Advanced technologies such as Artificial Intelligence (AI) and Augmented Reality (AR) enhance constructivist methods by providing students with profound and interactive learning experiences. However, ensuring equitable access to technology and maintaining active participation in virtual environments continues to present challenges, especially in certain regions (Ament & Edwards, 2018; Andina et al., 2019; Bordoloi et al., 2021; Collins et al., 2018; Janelli, 2018; Lawrie et al., 2016; Nagar & Maskit, 2016; Shaver, 2017). The pandemic accelerated shifts in constructivist educational methods. It highlighted the importance of adaptability and creativity in teaching strategies and demonstrated how technology can support constructivist education. Looking ahead, there are opportunities to enhance and expand these practices to be more inclusive, sustainable, and effective in meeting the diverse needs of students in the post-pandemic era (Hamutoğlu et al., 2024; Luca et al., 2021; Zarzycka et al., 2021).

During and after the COVID-19 pandemic, there was a significant increase in the effectiveness and engagement of online learning, supported by various technological, cognitive, and motivational factors. The study by Fang et al. (2023) showed that student engagement significantly influenced satisfaction with online learning ($\beta = 0.66$, $^*p < .001$), with more substantial interactivity effects in China ($\beta = 0.57$) compared to Australia ($\beta = 0.11$). Constructivist strategies based on active student contributions also demonstrated notable effectiveness, such as a 7% increase in final scores through the PeerWise platform (Howe et al., 2018) and improved scientific process skills through LMS-based flipped classrooms ($p < 0.05$, $\eta^2 > 0.35$) (Elfeky et al., 2020). Furthermore, MOOC-based online learning communities progressively enhanced cognitive engagement (Atapattu et al., 2019), and higher discussion quality was recorded in large-scale classes, where the number and length of threads increased significantly ($r = 0.707$ and $r = 0.479$) (Qiu, 2019). Social media technologies like Facebook and LinkedIn supported students' collaborative communication (Zarzycka et al., 2021), contributing to academic engagement with $R^2 = 0.292$. The implementation of Type 1 blended learning significantly affected learning outcomes ($R^2 = 0.404$) and behavior toward LMS ($R^2 = 0.719$)(Manzanares et al., 2020).

In contrast, pre-pandemic conditions reflected limited use of collaborative technologies, with only 20.8% of teachers using Google Docs and 10% using Wikis as learning tools (Nagar & Maskit, 2016). After the pandemic, increases were observed in interactivity and e-learning satisfaction scores (from 4.02 to 4.21 on a 5-point scale)(Bashir, 2019), as well as the effectiveness of computer simulations such as PhET, which resulted in higher post-test scores (11.05 vs. 10.66) (Ouahi et al., 2021). Blended learning models based on JiTT and PLTL reduced dropout rates from 10% to 4% and increased graduation rates from 60% to 81% (Pourdana, 2022). Additionally, implementing Dynamic Interactive Assessment (DIA) significantly improved students' writing scores ($F = 388.003$, $p = 0.000$, $\eta^2 = 0.230$). The factor of learning presence also emerged as a significant predictor of perceived learning ($\beta = 0.274$, $p < 0.05$) (ElSayad, 2023), signaling a shift from teacher dependence toward greater learner autonomy. Nevertheless, new challenges have also emerged. Aljohani & Aljehani (2024) reported low scores for Teacher's Presence ($M = 1.94$) and Cognitive Presence ($M = 2.00$), along with a negative impact on the community of practice ($\beta = –0.27$), indicating that the social and affective dimensions of constructivism still need to be strengthened in digital learning contexts. Thus, the development of constructivist approaches in the post-pandemic era has shown significant progress in the effectiveness of online and hybrid learning through advanced technologies and participatory strategies. Various studies have demonstrated that student engagement, interactivity, and the implementation of contribution-based methods can substantially improve learning outcomes and satisfaction.

**Opportunities and Challenges**

Applying the constructivist approach in online and hybrid education presents various opportunities and challenges that can be systematically analyzed through a sociotechnical framework. From the social perspective, constructivism creates opportunities to enhance student engagement through active,

collaborative, and reflective learning. Virtual collaboration platforms, gamification, and online communities foster interaction among learners across locations, broadening perspectives and building collective knowledge (Archambault et al., 2022; Martin et al., 2023; Richter & Jung, 2023). Additionally, this approach allows for creating inclusive and diverse learning spaces, provided that teachers are prepared to serve as guides and facilitators (Mittal & Alavi, 2020). However, the social dimension also brings significant challenges, such as low participation and engagement in virtual environments, particularly when students lack adequate social support or a conducive learning environment. Young children, for instance, require more structure and guidance compared to university students, who tend to be more independent and need space for critical analysis and complex group projects (Fang et al., 2023; Huang & Lajoie, 2023; Xu et al., 2024). From a technical perspective, advancements in digital technology offer substantial opportunities for constructivist implementation. The use of Learning Management Systems (LMS), virtual reality (VR), augmented reality (AR), and adaptive learning systems enables more personalized, immersive, and interactive learning experiences. These technologies support flexible learning and accommodate various student learning styles. However, the main challenges in this area include the digital divide, which limits access to devices and high-quality internet, especially in remote and low-income areas. Other technical barriers include low digital literacy and limited technical support and infrastructure, which may hinder the success of constructivist-based learning (Collins et al., 2018; Mystakidis et al., 2021). By understanding the opportunities and challenges through this sociotechnical approach, strategies for implementing constructivism in online and hybrid education can be more comprehensively designed. Efforts to improve the quality of learning must include teacher training, providing inclusive technologies, and strengthening learning communities to foster a reflective, collaborative, and sustainable digital learning environment.

**Sociotechnical Factors in Implementation**

A combination of social and technical elements interacting to either enhance or impede the learning environment shapes the efficacy of constructivist methods in online and hybrid education. Social elements are essential as constructivism depends on cooperation, interaction, and active involvement. These include student involvement, peer-to-peer connections, and community building within the school environment. A supportive business culture is also essential; it comprises teacher readiness and encouragement of active learning. Guaranteeing inclusiveness in virtual environments, teachers must transform into their new roles as facilitators, designing activities that promote critical thinking and problem-solving (Mittal & Alavi, 2020; Mystakidis, Fragkaki, et al., 2021; Nagar & Maskit, 2016; Tayjasanant & Suraratdecha, 2016). The availability and lifetime of digital resources greatly influence the efficacy of constructivist technology methods. Simple interfaces, fast internet connections, and strong learning management systems (LMS) encourage active participation and smooth interaction. By providing immersive and engaging experiences, advanced technologies such as Gamification, Virtual Reality (VR), and Augmented Reality (AR) enhance constructivist education. Especially in resource-constrained settings, technological constraints such as the digital divide, lack of technical support, and data security concerns could undermine the efficacy of this strategy (Collins et al., 2018; Mystakidis, Berki, et al., 2021; Mystakidis, Fragkaki, et al., 2021).

Addressing both social and technical factors simultaneously is essential to maximizing the potential of constructivism in online and hybrid learning. A balanced approach that integrates social strategies to build a strong learning community with reliable and innovative technical solutions can significantly enhance learning outcomes.

**Table 8.** Social and Technical Factors Influencing the Implementation of Constructivism in Online and Hybrid Learning

| Category | Factors | Impact |
|---|---|---|
| Social Factors | Student engagement | Promotes active learning and collaboration. |
| | Peer interaction and community-building | Enhances sense of belonging and collective knowledge. |
| | Teacher preparedness and facilitation skills | Encourages critical thinking and structured discussions. |
| | Inclusivity and diversity | Ensures participation from diverse learner groups. |
| | Organizational support and active learning culture | Creates an enabling environment for constructivist methods. |
| Technical Factors | Accessibility to technology (e.g., LMS, devices, high-speed internet) | Ensures equitable participation and connectivity. |
| | User-friendly and reliable digital platforms | Reduces technical barriers and enhances usability. |
| | Use of advanced tools (e.g., VR, AR, gamification) | Creates interactive and immersive learning experiences. |
| | Data security and privacy | Builds trust in using digital platforms. |
| | Availability of technical support | Reduces disruptions and supports smooth learning. |

## DISCUSSION

The role of constructivism in online and hybrid learning has undergone a fundamental transformation before and after the COVID-19 pandemic. Before the pandemic, constructivist approaches were more commonly applied in face-to-face contexts, where project-based learning, group discussions, and direct interactions dominated the educational process. This aligns with Piaget's theory, which emphasizes the importance of assimilation and accommodation processes in students' direct interactions with their environment to build cognitive schemas (Pakpahan & Saragih, 2022). Meanwhile, Vygotsky's approach places greater emphasis on the social dimension of learning through the Zone of Proximal Development (ZPD)(Lasmawan & Budiarta, 2020), which was widely adopted in post-pandemic online contexts through discussion forums, virtual mentoring, and peer learning. Furthermore, Bruner's spiral approach is reflected using LMS and flipped classroom models that allow for gradual and contextual representation of learning materials (Garinganao & Bearneza, 2021). The pandemic accelerated the adoption of technologies such as LMS, AR/VR, gamification, and AI, which expanded the reach of constructivism into digital spaces. This extended the meaning of "scaffolding" as described by Bruner and reinforced Kolb's notion of reflective learning experiences (Bell & Bell, 2020). Findings from studies such as Bordoloi et al. (2021) and Adigun et al. (2024) support the idea that independent and reflective learning can be effectively facilitated through integrating technology within constructivist approaches.

Nevertheless, important contradictions exist within the literature. While some studies highlight the success of blended learning in enhancing motivation and academic performance (Manzanares et al., 2020; Ntim et al., 2021), other studies, such as Aljohani & Aljehani (2024), reveal low teacher presence and cognitive presence, which in turn decrease the quality of online learning communities. This suggests that technology alone is insufficient without pedagogical designs aligned with constructivist principles. On the other hand, although tools like PhET simulations have been proven to enhance science learning outcomes (Ouahi et al., 2021), only a small percentage of teachers (20.8%) adopted collaborative tools prior to the pandemic (Nagar & Maskit, 2016), indicating resistance to change and limited digital skills. From a comparative synthesis perspective, this study examines various contexts: from the Metaverse model (Funa & Talaue, 2024), hybrid Islamic learning (Sukiman et al., 2022), to digital science education (Nurwidodo et al., 2023). This research is more robust as it covers a more extended timeframe (2016–2024), spans multiple educational levels, includes

diverse technology platforms, and features VOS visualizations that reveal the interrelations among concepts such as e-learning, constructivism, and collaborative learning. The implicit matrix across these studies shows that while all recognize the importance of collaboration and reflection, their effectiveness heavily depends on each context's technical and social readiness.

Theoretically, these findings affirm that post-pandemic digital constructivism should be approached holistically: as an epistemological strategy (based on Piaget), socio-cultural (based on Vygotsky), and cognitive-structural (based on Bruner). Practically, education policymakers and curriculum developers must ensure that LMS and other technologies function as content delivery tools and as interactive spaces that support scaffolding, collaboration, and reflection. Teachers and lecturers must be trained to reposition themselves as facilitators rather than merely content transmitters. In addition, concrete solutions such as subsidized internet data packages, digital literacy training, and local technical support can help overcome the sociotechnical gaps that remain significant challenges. By integrating classical and contemporary theoretical insights and comparing findings across contexts and time, this study offers a strong conceptual and practical foundation for developing more resilient, adaptive, and human-centered constructivist digital learning strategies in the future.

These findings indicate that maximizing constructivism in hybrid and online education requires combining adaptive, inclusive technological support and student-centered pedagogical approaches. However, it is important to acknowledge this study's analytical and contextual limitations. First, the article scope was limited to English-language publications from four major databases (Scopus, ScienceDirect, SpringerLink, and ProQuest), which may have introduced language and publication bias by excluding local or non-indexed sources that could be more relevant to specific regions, such as developing countries. Second, selection bias may have occurred as the screening process was based on keywords and the PICOC framework, potentially overlooking relevant studies that used different terminology. Third, although quality assessment was conducted using the Kitchenham checklist and inter-rater reliability tested using Cohen's Kappa ($\kappa = 1$), the external validity of the findings should be interpreted with caution, as the majority of articles came from institutional contexts in the United States, China, and India, with limited participation from institutions in the Global South. This affects the generalizability of the findings, especially for primary education contexts or regions with limited digital infrastructure. Therefore, although this synthesis provides deep insights into global trends, its application locally or in low-tech educational environments requires contextual adaptation. Considering these limitations, the findings still offer a crucial foundation for the development of sustainable constructivist digital learning strategies, with the caveat that future research should employ more context-specific and localized approaches.

Furthermore, the implications of this study underscore the importance of integrating constructivist pedagogical design into digital platforms while considering users' social and technical readiness. Teacher training and digital infrastructure enhancement must become priorities to bridge the implementation gap across diverse contexts. Going forward, research and policy should focus on local adaptations and the development of learning models that respond to the diverse needs of learners.

## CONCLUSION

The application of constructivism in online and hybrid learning has undergone significant development before and after the COVID-19 pandemic. Before the pandemic, this approach was mainly implemented through direct interaction and collaborative projects in face-to-face classrooms. The epidemic, meanwhile, set off a quick move to digital education, therefore hastening the integration of technologies, including LMS, VR, and AR, which supported self-directed learning, online forums, and project-based learning. Key emerging opportunities include learning flexibility, personalization, and global engagement, while challenges involve the digital divide, limited technological literacy, and educator readiness. The efficacy of the constructivist method is powerfully shaped by social factors—such as student involvement and institutional support—and technological ones, such as access to technology and platform dependability. Constructivism still develops as

a relevant and flexible tool for promoting student-centred, reflective, and cooperative learning experiences in the digital age. Conversely, this research has several shortcomings. Although a systematic review method was followed, the literature studied is limited to English-language publications in four major databases, perhaps overlooking relevant research from other sites. Second, the breadth of research focus across many educational levels and disciplines might undermine the depth of study in specific environments. Third, although thematic visualizations were conducted, further quantitative analysis on the influence of each factor has not been fully elaborated. As suggestions for future research, subsequent studies can adopt a more specific and contextualized approach, for instance, investigating the implementation of constructivism in primary education or particular fields such as STEM or character education.

Additionally, mixed-methods or longitudinal studies may provide deeper insights into the long-term impacts of constructivist practices in digital learning. Research could also focus on developing constructivist learning models integrated with cutting-edge technologies such as adaptive artificial intelligence, data-driven learning, or educational metaverse environments. Through a more in-depth and innovative approach, the implementation of constructivism in online and hybrid learning can continue to improve in response to the increasingly complex and dynamic challenges of future education.

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