Original Article

Deciphering Themes and Trajectories: A Bibliometric Study on Learning Design & Technology over Four Decades

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ABSTRACT

The intersection of learning design with technology continually transforms the educational scene prompting deep study. Through an exhaustive bibliometric analysis powered by the myriad features of the Biblioshiny toolset from data procured from Scopus vast CSV file resource spanning 1977 to 2023. The study maps the evolution of themes within this field. It uncovers how initial conversations about e-learning foundations segued into contemporary dialogues on mobile learning approaches as well as pedagogical design intricacies. Central to this research is the identification of leading figures in the arena. Highlighting paramount authors or resources offers a tailored breakdown on texts crucial to shaping both past discussions as well as the directions learning design with technology might take in future. Analyzing scientific production trends helps understand shifts over time in the space between innovation bursts to periods demanding thoughtful consolidation. By intertwining theme progressions along with key contributors or resource findings with production pattern assessments, this research offers a holistic bibliometric panorama. It therefore condenses learning design with its technology-rich history in conjunction with the current state to guide future research directions in this critical educational field.

Keywords: Learning Design; Technology; Bibliometric

1. Introduction

Learning Design and Technology (LDT) involves using cutting-edge technology in combination with effective teaching strategies to upgrade education[1]. LDT's primary focus is on developing immersive and personalized education programs that empower students with the aptitude necessary for navigating today's digital landscape[2]. Today's educational landscape emphasizes the need for LDT amidst an ever-changing technological ecosystem that we see around us today in our academic settings. There is an ongoing effort by these institutes towards seeking cutting-edge techniques that can help them integrate technology into their teaching strategies with a view toward enhancing their students' learning outputs along with experiences[3]. The contemporary educational paradigm relies on LDT's ability to increase accessibility and promote personalized learning while catering to diverse student requirements, as stated by [4].

The trend shows that scholars are increasingly interested in understanding the research patterns and contributions made in LDT, and numerous exploratory studies have been conducted by researchers on various
aspects of LDT covering topics such as implementing new technologies in teaching practices to examining how technology alters methods used for learning\cite{6}. The LDT research domain has seen substantial enrichment thanks to these efforts, which were made in 2019. To gain valuable insights into the present trends of LDT while also identifying its shortcomings and pointing toward future research areas it is crucial to perform a bibliometric analysis\cite{40}.

The field of Learning Design and Technology (LDT) has seen considerable growth during the past few years; however, a dearth exists when it comes to conclusive analyses of the academic literature capturing its range as well as its depth within this arena as observed by Morrison et al. There exists a wide range of research in the field of LDT which has stemmed from several perspectives exploring different themes and geographies. Researchers are often faced with challenges when attempting to ascertain current fields of inquiry or effectively contribute valuable insights if they do not possess a holistic perspective on the topic at hand.

One possible approach to address the need is by conducting a bibliometric study, as a quantitative methodology such as bibliometric analysis can provide meaningful insights into scholarly literature patterns that might otherwise be missed\cite{6}. We can gather substantial knowledge about the LDT research landscape by viewing it panoramically - this includes vital data like most influential publications and key contributors along with an overview of prevalent themes\cite{7}. The macroscopic view offers a valuable way to illuminate the broader trajectory of LDT research which allows stakeholders to make informed decisions related to strategy.

Our aim through this research paper is to examine scholarly literature in the field of Learning Design and Technology (LDT) via bibliometric analysis, which is particularly beneficial for gaining insights into the structural development and evolution of a specific area based on the systematic examination and evaluation of research trends\cite{6}. In their recent work on LDT research contributions it is proposed that such studies can lead to an extensive statistical examination on scholarship's participation within this lively area.

Through its identification of key research themes and major contributors in LDT this study is set to make a meaningful contribution. Furthermore, through tracing the trajectory of this field across time scholars can identify emerging areas of study and contribute to future directions for research\cite{7}. Exploring the research landscape within LDTs enables educators and policymakers to make evidence-based choices that align with their interest. In addition, conducting a bibliometrics study helps to solidify and harmonize ideas within the realm of LDT leading to more clarity and coherence. The intellectual arrangements within LDT studies became clearer through this analysis by categorizing known themes to help discover emerging trends while highlighting strong interdisciplinary connections for future work\cite{11}.

Given the above, this study sets out to achieve the following research objectives:

(1) To conduct a comprehensive bibliometric analysis of the scholarly literature in LDT.

(2) To identify and examine the key research themes, influential publications, and major contributors within the field.

(3) To trace the evolution of LDT research over time and to identify emerging research frontiers.

(4) To inform future research directions and policy decisions in LDT.

These results from our bibliometric study hold considerable weight for numerous stakeholders operating within Learning Design and Technology (LDT) and the broad-ranging implications for further research that these thorough and numerical assessments of LDT literature provide are noteworthy. By revealing key recurring topics that researchers have examined in this area and uncovering key gaps or opportunities to explore new ideas further, we hope that these findings support future work conducted here. According to \cite{6} study results, researchers may be assisted by it in devising their research schedules while motivating new strands of investigation. Policy makers can use these findings to create effective evidence-based strategies and programs for addressing the changing needs and challenges in LDT. Familiarity with key trends and trajectories helps policymakers to develop policies that promote excellence in the field with an emphasis on innovation\cite{7}.

Becoming informed by these insights will not only enhance understanding of effective LDT practices but
will also aid in making informed choices when it comes to integrating technology into their teaching strategies\[11\].

2. Literature Review

To enhance the process and results of education through \[12,13\] technology, LDT applies knowledge and techniques creatively \[7\] and looking at it historically reveals that LDT originates from the mid-twentieth century's programmed instruction and audiovisual education movements. During its formative years the field concentrated largely on using technology as a means to advance customary instructional methods. The initial technological breakthroughs in this area involved incorporating filmstrips and overhead projectors along with audio tapes to supplement classroom learning\[8\] but with the passage of time the field embraced technological advancements and incorporated sophisticated design principles for better learning\[14\].

This development was greatly influenced by the rise of the digital era. Advancements in computing such as personal computers and mobile devices have paved the way for incorporating technology into learning experiences\[9\], considering technology as an indispensable part of education has resulted in a wide range of technology-enhanced learning spaces\[3\]. Collaborative and tailored study sessions are facilitated through utilizing technology as a tool within the context of LDT. With its focus on integrating instructional design with learning theories as well as\[16\] technological expertise\[15,17\], it seeks to enhance the efficiency and effectiveness of studying.

In Learning Design and Technology (LDT) research it has been established that technology plays a crucial role in learning and instruction. The history of technologies used for education spans from simple audiovisual aids like filmstrips and overhead projectors to early computer systems. In light of the digital era we now have access to a more varied and advanced range of educational technologies. Flexible, personalized, and\[30\] interactive learning environments are now possible thanks to digital technologies such as personal computers, internet, mobile devices, Multimedia Applications, and Learning Management Systems\[8,18,10\] cite advancements in artificial intelligence along with virtual reality and augmented reality as the main drivers widening LDT's horizon. These technologies have the potential to create immersive and authentic learning experiences while also providing support for adaptive and competency based-learning paradigms according to\[11\].

While there are manifold benefits to using \[24\] technology in the classroom, there are also obstacles to consider. Incorporating technology in education can lead to better learning outcomes by promoting collaborative activities for students while also allowing for formative assessments that build essential skills for the future\[12\]. Although progress has been made towards integrating technology into education system some challenges persist like inadequate technical competencies among both teachers and pupils as well as unbalanced technological access across different areas\[17\], there is an increasing emphasis on addressing data security concerns as well as ethical questions regarding the use of technology in current debates\[13\]. To conclude our discussion on the critical topic of LDT research, technology plays a vital role in improving learning. However, it has its own set of complexities that must be analyzed\[18\]. Learning theorists' insights are a crucial factor in the development of Learning Design and Technology (LDT) and there have been different learning theories that have informed instructional design and use of technology for learning\[19,26\].

Behaviorism, cognitivism, and constructivism have typically guided the development of LDT. However, it has been found that in computer-based training programs which apply reinforcement strategies for learning\[23\] the use of behaviorist principles is effective. Considering the limits of working memory falls under cognitivist principles and informs the design of multimedia learning environments (Mayer, 2011), while constructivist thinking has given rise to the creation of interactive problem-solving spaces for learners that help them in developing their understanding of a topic\[24\].

Theories like socioculturalism and constructivism are gaining popularity lately as they reflect how digital tech affects learning. Collaborative digital teaching platforms enabled through web 2.0 technologies have been developed based on the principles laid out by\[38\] sociocultural theories with regards to the pivotal role played by social interaction and cultural tools in facilitating effective knowledge acquisition. In an era where information overflows abundantly every
day around us, Connectivism becomes more relevant by highlighting the importance of both networked learning and knowledge management\[^{20}\].

Be achieved through the application of instructional design as a systematic approach to translating theoretical principles into practical applications. Increased comprehension and memory retention brought about by well-designed instruction can lead to improved learning outcomes according to Incorporating the principles of multimedia learning such as contiguity modality reduction has been shown to increase an individual's ability to comprehend retain educational information\[^{27,28}\].

To summarize earlier remarks made-gaining knowledge about learning theories is critical when it comes to designing effective teaching spaces. It's equally important to recognize that successful implementation of these based designs rely heavily upon good instructional design resulting in positive educational outcomes. Emerging technologies shape the field of Learning Design and Technology (LDT) over time Artificial Intelligence(AI), Virtual Reality(VR),(AR) Augmented Reality and Learning Analytics surpass other elements in importance in these developing matters. AI has revolutionized the way we approach education by providing intelligent tutors for individualized instruction and automating tasks such as grading essays while also offering adaptive learning platforms for every student's needs. By offering individualized instruction that molds itself according to learners' distinct feedback and requirements which results in better academic results is the promise of AI. For the sake of ethics and privacy considerations related to AI's data-oriented characterization it is necessary to take precautions. Revolutionizing teaching and learning is possible with VR and AR by creating experiential environments that aid in deeper understanding. In both medical and history educations, VR serves as an important tool respectively for surgical training and event recreation\[^{23}\]. By overlaying digital content over the real-world environment in just-in-time contexts AR allows for contextualized learning opportunities as discussed by \[^{31}\].

Data collection through the use of Learning Analytics can help provide powerful insights that will aid in understanding and improving the methods of teaching\[^{32}\]. Insights gained from this approach into student performance and engagement can inform instructional design for better personalized learning. \[^{33}\] predict a shift towards decentralized educational systems using blockchain technology and increased utilization of neurotechnology to enhance cognitive capacity. Yet these hypothetical trends do raise key questions about how to ensure both fairness and privacy in handling information.

When exploring emerging technologies that may shape the future of education it is vitally important to address their pedagogical implications along with technical feasibility as well as ethical dimensions by carefully considering what will promote effective learning outcomes which remain fair-minded.

The Learning Design and Technology (LDT) discipline has benefited greatly from the important works of notable authors, including\[^{34}\] extensive research on the cognitive theory of multimedia design and multimedia learning is considered instrumental in shaping technology-enhanced learning environments\[^{34}\] and as a result of his research on constructivist learning environments and problem-solving techniques\[^{25}\]. David Jonassen has become an eminent scholar. George Siemens played a vital role in this matter through introducing Connectivism theory which strongly emphasizes on the role of networks and technology for successful learning outcomes\[^{32}\]. LDT was greatly impacted by the revolutionary contributions of seminal works, and the design of multimedia instruction should incorporate principles that align with our knowledge about how the human brain operates. This is according to Mayer's 'Multimedia Learning' (2009) and according to Jonassen's 'Designing Constructivist Learning Environments' (1999), effective learning requires a genuine and contextual approach. By writing about 'Connectivism: A Learning Theory for the Digital Age', \[^{32}\] contributed significantly to improving educators' and researcher's knowledge of learning mechanisms in a digital age.

Multimedia designers should take note from research into multimedia design principles that found aligned audio and visual content resulted in more effective learning outcomes thus contributing to advancements in both instructional practices and media
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tool development[33]. Gaining insight into the scholarly scope of LDT by recognizing influential authors & works as well as comprehending key research findings would assist in informing the field's prospective avenues.

Analyzing the impact and influence of scholarly publications quantitatively through bibliometrics is crucial to gaining insight into research trends within LDT, and the structured approach presented by [34] allows us to gain insight into how the discipline has evolved having considered contributions from leading scholars.

To gain a comprehensive understanding of LDT, which is continuously evolving at a rapid pace; perform an intricate bibliometric assessment that addresses current information voids & highlights potential avenues for further studies.

Numerous analyses of publications within related topics yield beneficial findings, and the results of a bibliometric analysis carried out by [35] revealed how the focus has moved towards more collaborative and networked forms of learning as opposed to individual-based ones. Their research recognized noteworthy authors while identifying top academic journals and countries that contribute greatly to this particular field. Additionally, educational technology researchers have focused on important themes such as[21,29] blended learning and game-based learning according to [36]. Bibliometric study had limitations, however, as some of the latest themes in the LDT field may not have been accounted for by the otherwise informative studies. Conducting a bibliometric study exclusively for LDT will augment these attempts by delivering a more focused investigation of scholarly contributions in this field. Through an analytical process this tool can determine which authors have had a significant impact on a particular subject matter including their works as well as key research themes. Furthermore, a study of this nature may help shed light on potential emerging areas and directions that require further scrutiny to influence the course of LDT research and practice.

In summary, Learning Design and Technology (LDT) includes both extensive historical roots along with new evolving trends which can lead to inventive future technology. These concepts date back many years to a time when Instructional Design Theory’s key tenets laid the groundwork for what we still see today[41]. Adopting technology has brought about considerable benefits such as customized learning and enhanced outcomes although[37] challenges still exist Significant contribution towards the understanding of multimedia learning, constructivist environments, and networked learning brought by renowned personalities in LDT including.

New advances such as AI and VR indicate a fresh direction for the field through emerging technologies[22]. To fully comprehend emerging trends and scholarly contributions within LDT research community requires objectivity that can be achieved through the use of bibliometric analysis[40].

Even though there are existing bibliometric studies on relevant subjects[39]. This current study aims to overcome the gap by facilitating a detailed comprehension regarding LDT's development alongside its major players along with significant literature contributions and upcoming movements, thereby contributing to the already established body of knowledge. This provides valuable input into shaping future research direction as well as informing key aspects of education practice and public policies in this vital domain.

3. Scope and Methodology

The keywords used for this study in the Scopus database are “learning Design” and “Technology”. On limiting the search to publications in the field of Business Management and Accounting and considering only research articles in journals and conference proceedings, 666 publications were received as csv output as on 20th June 2023. These 666 articles constitute the scope of this research paper. We made use of the bibliometrix package in R to analyze, scrutinize, and use data visualization on this dataset which is a potent instrument developed specifically for exhaustive bibliometric analyses. This invaluable tool was fashioned by[42] primarily to help extract practical information from bibliographic data. Specifically created to handle the complex data structures characteristic of significant bibliographic datasets; it boasts a wide range of functions.
4. Analysis

4.1 Data summary

Table 1 depicts the summary of the input data. A total of 666 documents were published in the period 1977 to 2023.

<table>
<thead>
<tr>
<th>Description</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timespan</td>
<td>1977:2023</td>
</tr>
<tr>
<td>Sources (Journals, Books, etc)</td>
<td>266</td>
</tr>
<tr>
<td>Documents</td>
<td>666</td>
</tr>
</tbody>
</table>

4.2 Annual scientific production

![Annual Scientific Production](image)

Figure 1. Annual scientific production (Source: Biblioshiny).

Figure 1 displays the annual scientific production by year. As depicted in graph, from 1977 to 2003, there has been steady rate of publications but from 2004 to 2016 there has been increase in documents published in the concerned subject area. After year 2005, the production in each year has been in double digits. From 2018 onwards, more than 40 documents have been published each year. Since this data is as on 20th May 2023, the year is yet not completed. In just about 5 months of 2023, 25 documents have already been published. These trends clearly establish the interest of researchers in the field of training design and technology.
Figure 2. Most relevant sources (Source: Biblioshiny).

Figure 2 depicts the most relevant sources by number of documents produced. The top two sources i.e. British Journal of Education Technology and Education technology and Society alone hold 31% of total publications (56/180).

Figure 3. Most relevant authors (Source: Biblioshiny).

As far as most relevant authors are concerned, Bower M (14 publications), Hwang G-J (10 publications), Dimitriadis and Hernandez (8 each publication) have highest number of publications thus their work can be studied by scholars interested in the field of learning, design and technology, to know more about this field.

4.3 Most relevant keywords

Figure 4 depicts the most relevant keywords in the field of learning, design and technology. Teaching, students, e learning, education, learning designs, learning systems, engineering education, curriculum, design and learning are the most prominent keywords associated with concerned field of research. These keywords indicate the research trend.
4.4 Thematic analysis

To analyse how the research has evolved over period of time, the entire research period has been segregated into 3 time zones: initial period from 1977-2014, developing period from 2015-2020 and advanced period from 2021-2023.

Thematic maps are one method for analysing and visualising the study areas of an academic discipline. It is a coordinate system made up of centrality (x axis) and density (y axis), and it was first put forth by [43]. They claim that “centrality gauges the strength of a cluster's connections to other clusters. The stronger and more numerous the these connections are, the more this cluster considers a research problem as crucial by the research community” (p. 164), while “density characterises the strength of the connections binding the words in the cluster together. The more robust these relationships are, the associated research issues form a cohesive and integrated group.

**Figure 5(a), 5(b), 5(c)** represents the thematic maps of 3 phases.

### 4.4.1 Time slice-1

For the initial period (1977-2014), the thematic analysis is as below.

1. **Major Motor Themes**: Teaching, Design, Engineering Education.

Teaching and Design: This convergence highlights the importance of integrating design principles into educational methods. As instructional design gains prominence, this is the relevant trend.

Engineering Education: Engineering fields
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witnessed remarkable technological progress. Bridging engineering knowledge with teaching methods underscores the significance of engineering education.

(2) Other Motor Themes

Authoring Tool: Throughout the 20th century's latter stages, digital tools were adopted to augment educational experiences. With the rise of authoring tools, educators can now seamlessly create innovative learning resources.

Learning Theory: By uniting technological progress and conventional instructional methods, this theme greatly enhances the learning experience.

Group Activities: Technology-based collaboration is acknowledged as a vital component of modern educational practices, as seen in the heightened focus on group activities.

(3) Peripheral and Developed Themes: Delving into Human Interactions, LMS Learning Systems, and an Initial Programming Course.

These topics are intricately crafted but not the focal points. The shift towards LMS adoption underscores the growing significance of comprehending learner behaviors and requirements in educational technology development. The rise of programming courses is likely tied to the realization that these skills are indispensable.

4.4.2 Time slice-2

In time slice 2 (2015-2020), the themes and their probable background is as mentioned below.

(1) Central and Developed Themes: Education, Teaching, Students.

The primary emphasis continues to be placed on the fundamental principles of education. The rapid digitization of society created an urgent need to modify pedagogical approaches for a new breed of students.

Learning, Human, Education Technology, Internet, Curriculum:
This period represented a fusion of traditional learning approaches with technological resources, indicating a transition phase. By emphasizing ‘human’, the importance of student-centric approach in tech adoption in education is underscored.

Social Networking, Social Media, Software, Design:
This time frame witnessed a notable rise in the popularity of social media platforms for learning-related activities. These platforms’ potential was realized by institutions, leading to their integration for information sharing, peer learning, and community building.

Information Technology, Problem Solving:
The combination of these two elements suggests the growing priority of utilizing IT to bolster cognitive capabilities. With the incorporation of IT tools, students were better prepared to address real-world challenges via computational and critical thinking.

(2) Central and Underdeveloped Themes: Digital Devices, Economic and Social Effects, Learning Environments.
Despite being central to the conversation, these themes continued to develop. The advent of digital devices like tablets in classrooms marked a significant milestone, but their broader social and economic impact was yet to be evaluated. As with digital learning environments, there was a need to explore how to create them effectively.

(3) Peripheral and Developed Themes: Education Computing, Authoring Tools and Methods, Improving Classroom Teaching.
These themes, while not the main focus, carry substantial weight. The technology had advanced, enabling educational computing tools and platforms to mature. Both traditional and technologically-enhanced teaching methods were given equal importance, with an emphasis on refining classroom teaching methodologies.

STEM (Science, Technology, Engineering, and Mathematics):
In light of STEM’s growing influence, a global focus on education has become more prominent. STEM’s importance, though evident, remained in the background when compared to other themes like digital pedagogy or online learning[42].

(4) Peripheral and Underdeveloped Themes: Geography Education, Technology Adoption.
The relatively minor role geography education plays may result from its niche position in the educational sphere. Although this reference exists, it implies further examination of technological instruments.

The underdeveloped nature of technology adoption might indicate the challenges encountered by institutions while smoothly incorporating new technological tools into their curriculum.

In this period, educational institutions endeavored to incorporate and navigate the digital revolution. The study revealed mature and central themes along with evolving ones, underscoring future research opportunities.

4.4.3 Time slice-3 (2021-23)

Figure 5(c). Thematic map of Time slice 1 (2021-23).

In time slice 3 (2021-2023), the themes and their probable background is as mentioned below.

Post-pandemic Influence: The pandemic's impact significantly sped up the shift to e-learning, and by 2021, these platforms were widely used and at the core of global educational approaches.

Emphasis on Adaptive Curriculum: The multiple references to curriculum, learning designs, and systems highlight the significant attempt to transform traditional educational material for the innovative e-learning environment.

Teaching, Learning, Human Education, Students, Education, Distance:

Normalization of Distance Learning: The pandemic's impact caused distance learning to transition from being a secondary option to a prominent method in contemporary education.

Human Element Remains: The continued relevance of the human factor in education, even with technological enhancements, underscores its enduring value.

(2) Central and Underdeveloped Themes: Machine Learning, Predictive Analytics.

AI's Growing Role: As technology evolves, AI's potential in the educational realm becomes evident. Central to their current standing, their future importance is underscored.

Inception Stage: Currently, these technologies are still in their initial stages of adoption, resulting in their underdeveloped state.

(3) Peripheral and Developed Themes: Design/Methodology/Approach, Learning Analytics, Online Systems:

Refining Online Pedagogy: A mature understanding of their worth, even if not central, is evident in these themes. Online education requires refinement of instructional methods to yield optimal results.

Role of Data: By shedding light on students' behaviors, preferences, and performance, learning analytics greatly enhances online education, despite not being central to it.

(4) Peripheral and Underdeveloped Themes: Design and Technology, Instructional Designs.

Evolving Integration: These themes, though secondary, foreshadow developing research areas. As technology and instructional design continue to intersect, institutions strive to uncover the optimal methods for weaving these elements together seamlessly.

Mobile Learning:

Emerging Modality: The ubiquity of mobile devices provides a rich landscape for educational pursuits. Although mobile learning has potential, the challenge of creating tailored learning experiences for smaller screens and on-the-go situations means it's still an undeveloped and marginal aspect of main discussions.

The education sector is undergoing a radical transformation, driven by the swift digitization that accelerated during the pandemic and subsequent worldwide occurrences. While honing e-learning modalities, institutions are simultaneously delving into the realm of AI. Concurrently, a more complex landscape of educational design and technology integration is developing, revealing varied paths for future inquiry and advancement.

Figure 6. Alluvial diagram of thematic evolution.
**Figure 6** depicts the alluvial diagram of previously explained 3 time slices. It provides us a global view of the changes. Each of the nodes represents a cluster and is labeled by the first three words of the clusters, the edges are their temporal evolution track, generated by keyword co-occurrence of the topics between two time slices[43]. By examining the changes and developments in themes or topics through an alluvial diagram, valuable insights can be gained regarding the evolution of a given field.

**1977-2014:**
Clusters: The intersection of e-learning, professional development, teaching, education, and human resources is intricate.

E-Learning Emergence: The rapid growth of the internet and digital technology occurred during this timeframe. Institutions’ growing recognition of the value of online platforms helped to establish e-learning as a prominent force.

Emphasis on Human Element: The significance of "human" lies in the fact that, despite technological progress, the essence of teaching remains focused on personalized, human-centered approaches.

Professional Development & Teaching: As digital education emerged, there was an increased focus on educators' training and development to excel in this innovative environment.

**2015-2020:**
Clusters: The interconnectedness of education, cognitive systems, professional development, and learning experiences is evident.

Cognitive Systems and Learning: As the digital age took hold, interest in the cognitive aspects of learning expanded. By combining cognitive science and pedagogy, we can improve digital learning experiences.

Social Networking's Role: With the increasing prevalence of these platforms, educators began examining how social networking could support education, create communities, and aid professional development.

Factor Analysis: This method sheds light on a more detailed comprehension of education. To uncover patterns, preferences, and influential factors, factor analysis likely played a crucial role in digital learning outcomes analysis.

Continued Professional Development: Even with advancements, continuous learning and teaching methodology improvements are necessary for educators.

**2021-23:**
Clusters: Students, mobile learning, teaching, design/methodology/approach

Student-Centric Approach: By placing the spotlight on "students," education takes on a more individualized, student-oriented form. The advanced nature of online platforms allows for the seamless personalization of educational experiences.

Mobile Learning: The omnipresence of these devices fueled a growing interest in mobile learning. Educational institutions researched how to deliver content in a way that is accessible and flexible via these devices.

Design/Methodology/Approach: With digital education's advancement, attention turned to refining methodologies and approaches. As educators, we focused on perfecting and streamlining digital instruction techniques.

From 1977 to 2023, the thematic evolution shows the progression from simple e-learning to a more advanced digital education method based on analytics. The continuous evolution of education is reflected in each period, which represents a phase in response to technological advancements and changing global circumstances.

**5. Conclusion**

The fusion of technological advancements and pedagogical shifts during the specified period has given rise to a remarkable transformation of the educational landscape. A thorough thematic analysis of the educational landscape reveals its remarkable adaptability and resilience. From its early stages, e-learning has embraced the importance of human interaction, using technology to augment rather than replace the innate love for teaching and learning. In the mid-2010s, the blending of cognitive systems, a growing focus on analytical approaches including factor analysis, and the impact of social networking led to an education landscape that was open to adopting a wide range of tools and strategies.

Investigating educational themes across two time periods reveals the intricate interaction between technological advancements and the enduring
significance of pedagogical approaches centered on human needs. By combining bibliometric analysis with thematic insights, our research provides a thorough examination of the educational journey, covering almost 50 years.

During the timeframe of 1977 to 2014, the early years of e-learning saw a parallel development alongside a prominent focus on the human aspect of education. This era’s emphasis on professional development reflects the educational sector’s concerted effort to effectively incorporate digital tools, rather than replace established teaching approaches. As we analyzed the data, a richer interplay of themes emerged during 2015-2020. The sector's desire to enhance digital learning spaces through technological mastery and cognitive capabilities marked the infusion of cognitive systems. The rising importance of social networking and factor analysis highlighted a transformation towards a more analytical and data-driven mindset, complemented by the recognition of communal learning's enhanced influence in the digital sphere. During this time period (2021-2023), a decisive change towards student-centricity became evident, characterized by mobile learning and improved methodologies. A fusion of past wisdom and present-day creativity, this era represents the educational sector’s pursuit of balance. Running throughout these diverse thematic phases is a consistent thread, comprising an unrelenting commitment to professional development, an intertwined relationship between design and pedagogy, and a quest for perfecting the harmonious blend of technological advancements and human-driven teaching.

With hindsight, this study reveals the evolution of education, characterized by persistent adaptation and a steadfast pursuit of distinction. At the forefront of innovation, this thematic evolution mirrors our journey while serving as a beacon for the journey ahead. Unified, we must preserve the heart of education, cultivating comprehensive and impactful learning experiences amidst technological evolution.

6. Future Research Direction

The progression of educational topics from 1977 to 2023 provides a wealth of opportunities for in-depth analysis in the future. A central aspect of this trend is an increased focus on strategies that situate the learner at the centre of the education system[43,44]. This calls for a closer look at how constructing individualised learning experiences or adaptive academic modules may affect students from diverse backgrounds. Simultaneously, the fast-paced changes in technology — which include the advent of artificial intelligence (AI), virtual reality (VR), augmented reality (AR) — beckon research into their possible incorporation into teaching methods. This research aims to comprehend their impact on experiential learning. The subject of ongoing professional growth requires renewing attention. Specifically, scholarly efforts should inspect the overlaps between mastering new technologies; the art of teaching effectively; emotional adeptness required by teachers in a world reshaped by a pandemic. As digital platforms multiply in number rapidly, there arises an urgent need to discuss ethically managing heaps of learner data. Also pertinent is the query on potential discrimination emerging from education systems influenced by algorithms. A recurring focus on STEM from previous years points toward the compelling prospects of interdisciplinary knowledge especially where technology meets traditional academic subjects. However as digital learning goes mainstream globally it becomes crucial to study access equity worldwide to ensure fair outcomes. Comparing regions with different digital landscapes could shed light on any disparities that may arise from them that need bridging. Moreover mobile learning a rapidly growing area provides fertile opportunities for researchers to study long term cognitive impacts & realising advanced tailor-made mobile learning experiences. Finally the way social media is used in education a key feature from 2015-2020 is another dynamic area of research. Further studies can reveal how various old & new platforms facilitate communal learning foster student interaction & support professional growth. In conclusion past themes not only chart out the course of digital learning developments but also light up the journey ahead cast upon societal needs technological progress & enduring educational fundamentals.

7. Research Implications

This bibliometric analysis on learning design technology holds significance for a wide range of individuals involved in the industry. It presents to
educators as well as instructional designers a detailed historical journey from e-learning to mobile learning that serves as a guide for their development in educational tools. By significant authors being emphasized in the research paper, an extensive source of valuable insights is given to all educators for guiding their teaching strategies. The analysis also benefits academic researchers by grounding them in an established scholarly structure so they can recognize gaps in current studies which in turn can lead to new explorations within the field. The study’s outcomes provide all the information needed for edtech developers to figure out potential areas where innovation can be applied. This is particularly relevant with the current shift towards mobile learning along with the changes in learning designs. These findings thus allow developers to make sure that new technologies match the contemporary educational environment. Policymakers also gain knowledge from the analysis that will enable informed decisions that are in line with educational technology trends. This paper provides an understanding of how educational policies can shape strategies regarding curriculum changes or infrastructure upgrades to align with global standards. Students greatly benefit from these plans as more evolved teaching methodologies provide an education that meets digital era requirements — engaging students in an effective manner while preparing them for the future. Finally for investors looking to back edtech startups or academic research programmes; the study provides clarity on how they can allocate funds to ensure promising returns on their investment. The analysis illuminates understanding of the journey of learning design tech from past to future helping stakeholders make informed decisions.

Author Contributions

Conceptualization SM and AD; validation, AMM; formal analysis, SK; investigation, SAM, original draft preparation SM; writing — review and editing AD visualization, AMM; supervision, AD project administration, AD; funding acquisition NA . All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

We declare no conflict of interest.

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