education sciences

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Article

Learning Design versus Instructional Design: A Bibliometric Study through Data Visualization Approaches

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Abstract: The terms instructional design and learning design have been widely used to describe a discipline concerned with improving the process of teaching and learning. However, though both terms are interchangeably used and share a common vision, both terms are used to encompass different aspects of the learning and teaching. In order to better understand the evolution, map intersections and differences of these terms, and identify emerging themes, using text mining and social network analysis approaches, a triangulated bibliometric study was carried out to analyze a total of 514 publications (326 for instructional design and 157 for learning design) indexed in the Scopus database using text mining and social network analysis. Our first round of analysis revealed four broad themes for instructional design: Theory-driven approaches; technology-informed designs; instructional design for higher education; and assessment and evaluation. A second round of analysis for learning design identified four major themes: Design thinking and user experience-driven approaches; online learning informed designs and online environments; analytical approaches for assessment and evaluation; and engagement-based learning design. The study concludes that while instructional design is about developing, assessing, and evaluating instruction, learning design is more about learner engagement and experience, which can be assessed and enhanced by analytical and technological approaches.

Keywords: instructional design; instructional systems design; learning design; learning experience design; learning engineering

Citation: Saçak, B.; Bozkurt, A.; Wagner, E. Learning Design versus Instructional Design: A Bibliometric Study through Data Visualization Approaches. *Educ. Sci.* **2022**, *12*, 752. https://doi.org/10.3390/educsci12110752

Academic Editor: John Traxler

Received: 6 September 2022
Accepted: 24 October 2022
Published: 27 October 2022

1. Introduction

The educational landscape is in a state of constant change due to many reasons including technological advancements, capacity increase in teaching and learning tools, accessibility options to learning materials, and so on. Apparently, there is a deep and profound paradigm shift in the educational landscape. In a constantly changing world, teaching and learning are not immune to these changes, and new ways and approaches to design these processes are adopted in response to ongoing changes and shifts in our paradigms. In this sense, the researchers of this paper assume that a bibliometric study literally gives us a look at the relative impact some of the foundational influences are having on the evolution of instructional and learning design fields. In this context, this paper examines instructional and learning design concepts with a comparative approach to better understand their similarities and differences.

From Instructional Design to Learning Design: A Continuum

Instructional design can be defined as systematic procedures that need to be planned when applying the knowledge of human learning, which include the various processes of learning as well as external and internal stimuli that affect learners [1]. Instructional designers have been defined as experts who have, "the disciplinary knowledge including learning

theory, ID theory, ID models while keeping up with advances in technology" [2] (p. 7). They also possess other key characteristics such as specific ID-related skills (including analysis and problem identification, design and solution generation, project management) and certain dispositions (adaptability, flexibility, intentionality, and openness) [2] In addition to these core skills and competencies, skill sets including, "effective teaching capability, communication skills, time management, problem solving or troubleshooting, stakeholder management, diplomacy, relationship building, and emotional intelligence" [2] (p. 65) have been defined as being as important as the hard skills such as knowledge of learning environments, multimedia development, and communication design [3].

Instructional designers employ their skills of design instruction in a systematic way by using instructional design models. ADDIE has been the most popular instructional design framework employed for online education purposes followed by other models such as 4C/ID, ASSURE, ARCS, Diamond, Dick, Carey and Carey, Gentry, Morrison, Ross, Kalman, and Kemp [4]. ADDIE has been applied in a wide variety of educational contexts—ranging from 3D virtual environments to digital game design, according to a recent study conducted by Stefaniak and Xu [4]. The majority of the studies reporting on the use of models in their design work were conducted in higher education settings [4].

During the third decade of the 21st century, the term instructional design still encompassed the wide variety of practices and approaches that focus on design and improvement of learning, and since instructional design was first established as a field, different learning approaches and, therefore, different terminology, began to emerge such as learning design [5,6]. Wasson and Kirschner [7] define learning design as a different mindset where the focus is on the goal, which is learning, rather than the approach, which is instruction (as in instructional design). The term learning design can be more inclusive since it accounts for the instructional design practices encompassing a wider range of instructional approaches and environments as well as non-instructional interventions, applications, experiences, and systems.

Learning design approach advocates a shift from a focus on content to a focus on learning experience [7,8]. For this reason, the concept of learning design has been influenced by ideas such as design thinking, user experience design, which eventually led to the creation of a relatively new practice called learner experience design. The influence of design thinking as an approach or methodology to creative problem solving was first established when design thinking was proposed by the Hasso-Plattner Institute of Design at Stanford (d.school), which was founded in 2005 at Stanford University [9]. The proponents of design thinking laid out the five stages of design thinking (empathize, define (the problem), ideate, prototype, and test) to approach design problems creatively, yet systematically by empathizing with users.

Design thinking is fundamentally learner-centric, as the goal of all such design efforts initially involves developing a sense of empathy with the user [10], and it has affected other practices such as user experience (UX) design, where the main goal of design initiatives is to create products to provide meaningful and relevant experiences to users [11].

Learning experience design (LXD), which has its roots in user experience design, is an attempt to integrate design practice from related practices (i.e., human-computer interaction, product design, software design) with instructional/learning design [12,13]. The main motivation behind LXD practices is creating higher quality learning experiences utilizing different tools and approaches in comparison to traditional instructional design practices; in other words, learning is more than just accomplishing goals and meeting certain requirements [13].

Along this continuum of different terminologies, a new term called learning engineering eventually emerged as a result of the growing need to understand learner experience from a scientific and evidence-based perspective. Though learning engineering has recently become more popular, it has been more than 50 years since Nobel Laureate Herb Simon first called for this new field of technical competence in the learning domain [14]. Learning engineer is a professional title that has emerged, which encom-

passes a broad variety of "skills and competencies from data science, computer science, and the learning sciences focusing on technical standards, technology-based tool and platform solutions, and instrumentation" [15] (p. 9). The desire for adding learning engineers to instructional and learning design initiatives was clearly articulated by members of MIT's Online Education Policy Initiative Group [16]. Their recognition of the growing need for evidence-based progress in learning and interdisciplinary integration, has been demonstrated in several recent higher educational initiatives including the Empirical Educator Project (http://empiricaleducators.net/ accessed on 10 October 2022) and Carnegie Mellon University's Simon Initiative (https://www.cmu.edu/simon/ accessed on 10 October 2022). In addition to these higher educational initiatives, the IEEE has launched their Industry Connections Industry Consortium on Learning Engineering (ICICLE) initiative (https://sagroups.ieee.org/icicle/ accessed on 10 October 2022) to support the development of learning engineering as a profession and as an academic discipline. Schmidt Futures and the Chan Zuckerberg Initiative are two leading foundations that have collaborated to support several major learning engineering initiatives. Other supportive agencies include the (US) Institute for Education Sciences (https://ies.ed.gov/ accessed on 10 October 2022), (US) National Science Foundation, the Bill & Melinda Gates Foundation, and others.

These different practices and their accompanying terminologies were influenced by our collective, yet ever changing approaches to how learning should be designed. However, there are still different viewpoints on what these terms entail [5,6,17,18]. From an epistemological perspective, it is crucial to understand the implications and true meanings of these various titles to be able to frame future practices and establish credibility. In this paper, the main goal is to provide an interpretation of the use of different terms and offer a glimpse of future directions (instructional design, learning design, and other learning design-based practices) based on a bibliometric analysis of research articles and conference proceedings through data visualization approaches.

2. Materials and Methods

This bibliometric study adopts data mining and analytic approaches and uses social network analysis (SNA) [19] and text-mining [20] to map and visualize the research data [21], systematically review sampled publications, and investigate the research in question. The main purpose of using data analysis approaches is to triangulate the data [22] and, thereby, increase the reliability and validity of the study results. In this regard, data mining and analytic approaches use three types of metadata from scholarly publications. These are titles, abstracts, and keywords. Text-mining examines titles and abstracts by using, "two stages of co-occurrence information extraction—semantic and relational—using a different algorithm for each stage" [23] (p. 262), and this approach is helpful to reveal hidden lexical patterns. SNA "provides powerful ways to summarize networks and identify key people, [entities], or other objects that occupy strategic locations and positions within a matrix of links" [19] (p. 6). Approaching from this perspective, keywords of the sampled articles are analyzed based on their co-occurrences and visualized on a network to identify the keywords that hold strategic positions and explore the relationships among each other. SNA was helpful in identifying the invisible ties that connect the keywords and reveal their network by showing the significant keywords that hold strategic positions in the network. For benchmarking purposes, it should be noted that the researchers used Leximancer for text mining and NodeXL for social network analysis.

In the related literature, there are different examples of using bibliometric studies using text mining and social network analysis to identify research trends and patterns. For instance, in addition to examples using data mining approaches on instructional design [24] and e-learning [25], a study using the same approaches mapped and visualized the blended/hybrid learning research [26]. Besides, some other papers used text-mining [27] or SNA [28,29] to develop an understanding of the research in question. These studies are useful in terms of gaining deeper insights and depicting a broader perspective on the research

in question. Besides, adopting a meta-perspective and interpreting the related literature is useful to bridge scattered studies on a related topic, as in the case of the instructional design and learning design, either for purposes of reinterpretation or interconnection [30]. Besides, such studies are helpful to summarize, synthesize, draw conclusions, identify research gaps, and provide suggestions for future research [31].

2.1. Inclusion Criteria and Research Sample

The sample of this study consisted of a total of 513 publications. Of all the publications, 326 (321 articles and 5 conference paper) were about instructional design and 157 (146 articles and 8 conference paper) were about learning design. The inclusion criteria were that the publications be indexed in the Scopus database, written in English, have the search terms in their titles, and published in the social sciences discipline. Scopus was chosen as it is the largest database that indexes peer-reviewed publications. The rationale to include publications in English is to generate meaningful concept maps and identify the lexical patterns through text mining.

2.2. Data Analysis and Research Procedure

The study used three types of analysis. First, descriptive statistics regarding time trend was used. Second, text-mining was used to analyze lexical relationships in the titles and abstracts of the sampled articles. By using machine-based algorithmic analysis, text-mining enabled researchers to analyze the co-occurrences and lexical relationships and then visualize the lexical patterns on a concept map. Last, SNA was used to investigate keyword patterns. By using SNA, researchers identified strategic and critical keywords on a connected network graph where keywords are represented as nodes and their relationships are represented as edges. The patterns visualized through text mining and network maps revealed through SNA are used to identify research themes that were reported and discussed in the Findings and Discussions section.

2.3. Limitations

There are some limitations and strengths to acknowledge. First, the study examines a large data corpus through data mining and analytics approaches and the findings identified are free from human bias. Second, SNA and text-mining enable us to reveal hidden, previously invisible patterns in a large body of data corpus. However, in addition to the above-mentioned strengths of the study, there are some limitations to acknowledge. First, the study examines only papers published in English. Second, while the study uses Scopus, the largest scholarly database, the findings of this study can still only provide a partial view. Third, though not included in this study, authors of this paper acknowledge that papers in grey literature can provide additional supplementary views as they potentially reflect the practices in the applied field. Fourth, to have a concentrated view, the research corpus included publications under the social science category in the Scopus database. Finally, the findings of the study are limited to scholarly publications. The authors of this study acknowledge that complementary findings may be available in practice.

3. Results and Discussions

3.1. Instructional Design

3.1.1. Time Trend Analysis of the Instructional Design-Related Publications

In order to understand how the frequency of the term "instructional design" changed over time, the publications indexed in the Scopus database which have the term "instructional design" in their titles were analyzed. These publications included 326 articles in total including 321 articles and 5 conference papers that were published between 1966 and 2020 (see Figure 1) with the first article in the research corpus published being Glaser's seminal work titled *Psychological Bases for Instructional Design* [32]. The results of the analysis demonstrated that, overall, there is an upward time trend in the use of the term "instructional design." These articles were published over a 34-year period between 1966 and 2000. The

publication releases have been accelerating in the past 20 years since 2000—the frequency of the publications increased from 5 to 18 in terms of frequency (Figure 1).

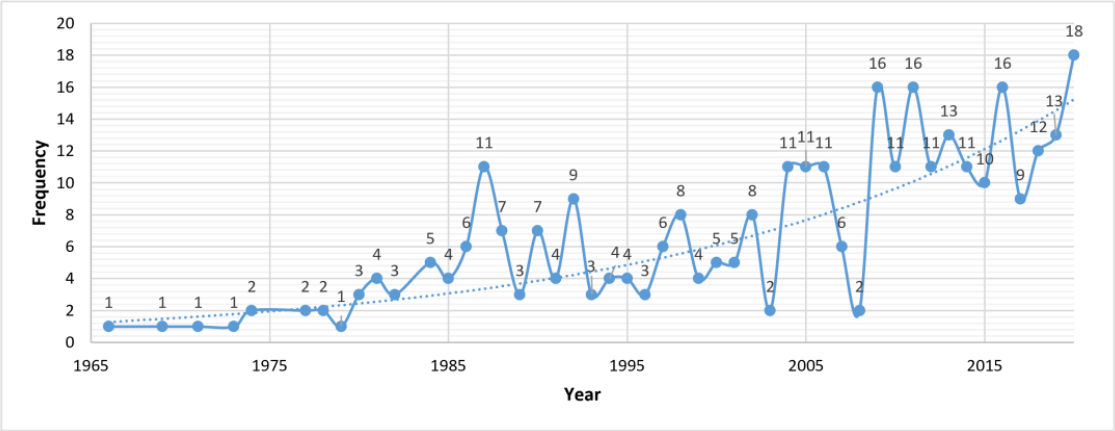

Figure 1. Time trend analysis of the instructional design-related publications (Forecast curve is shown as dot line).

3.1.2. SNA and Text Mining of the Keywords for Instructional Design-Related Publications

A social network analysis was conducted for the same 326 instructional design-related articles in order to better understand the networked structures in terms of nodes also known as related units within this network (see Figure 2). The resulting nodes were compared in their relative relation to the main node which is the keyword instructional design. In addition, a lexically connected thematic map for instructional design-related papers was also generated (see Figure 3). In terms of understanding how these terminologies differ, the data mining and social network analyses used in this study were helpful in visualizing and mapping underlying network connections between these terminologies. The results of the analysis of the words that are linked to the instructional design keyword were combined and categorized under four main themes: (1) Theory-driven approaches, (2) technology-informed designs, (3) instructional design for higher education, and (4) assessment and evaluation.

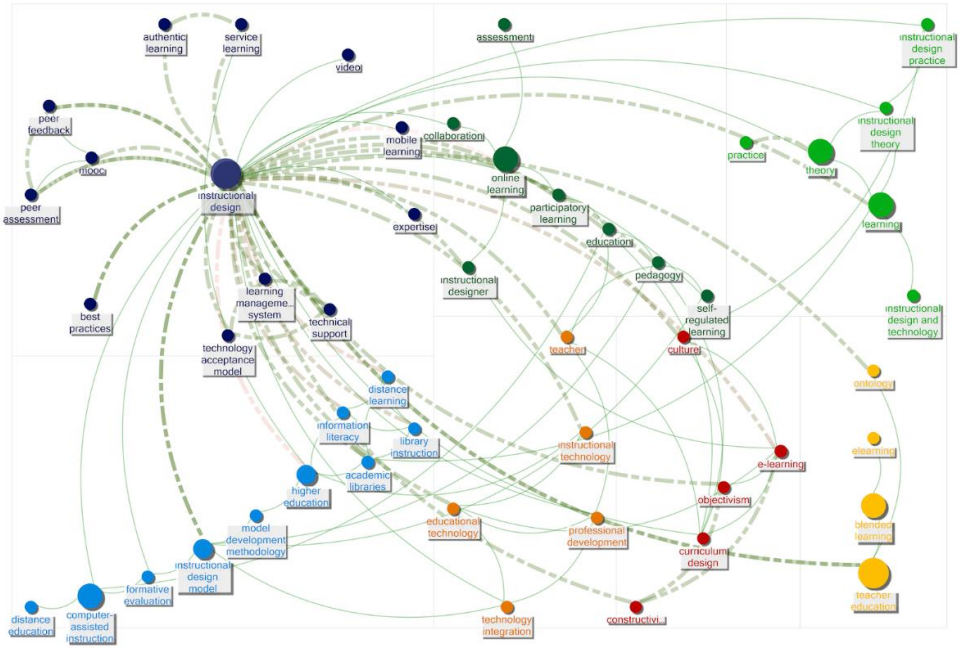

Figure 2. SNA of the keywords for instructional design related papers.

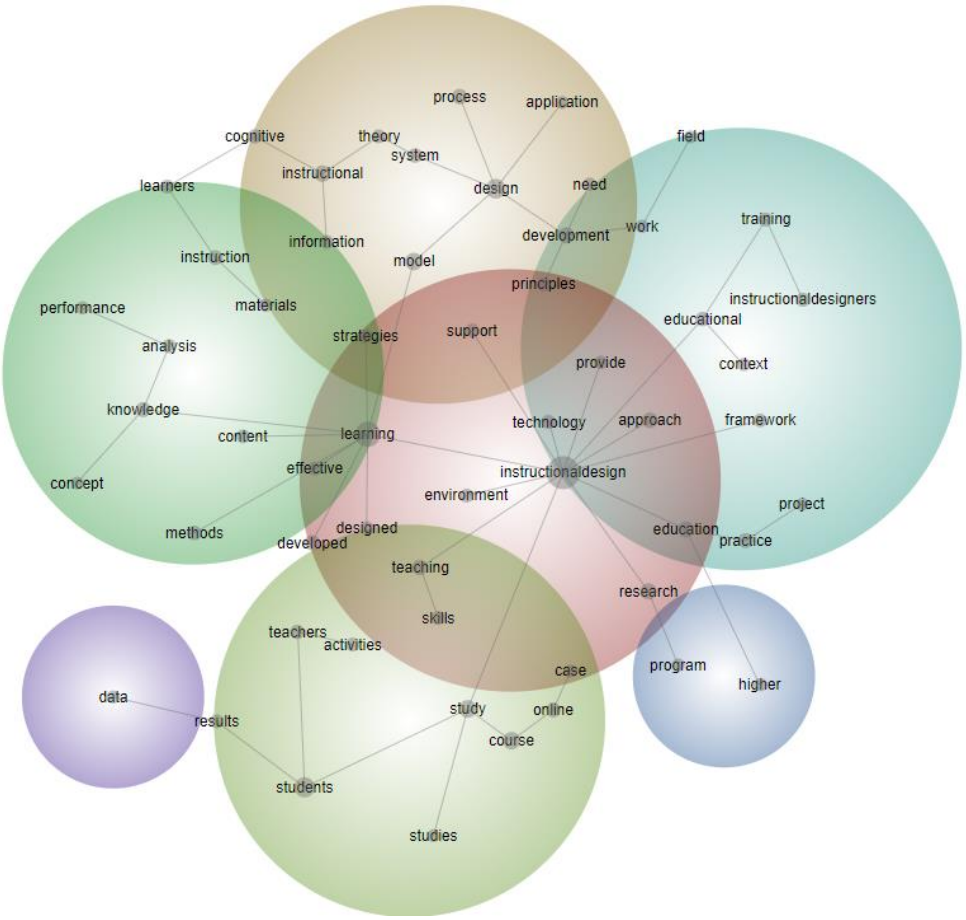

Figure 3. Lexically connected thematic map for instructional design related papers.

Based on the analysis, the keywords that are linked to the keyword instructional design were combined and categorized under four main themes:

1. Theory driven approaches (see the nodes in Figure 2: instructional design, theory, instructional design model, pedagogy, objectivism, constructivism, model development methodology, self-regulated learning; see the path in Figure 3: information, instructional, theory, system, design and design, development, principles and design, model, learning, strategies and framework, instructional design, approach).
2. Technology informed designs (see the nodes in Figure 2: online learning, computer-assisted instruction, e-learning, educational technology, technology integration, technology acceptance model, learning management system, mobile learning, instructional design and technology; see the path in Figure 3: technology, instructional design, environment).
3. Instructional design for higher education (see the nodes in Figure 2: instructional design, higher education; and see the path in Figure 3: higher education, instructional design).
4. Assessment and evaluation (see the nodes in Figure 1: formative evaluation, peer assessment, peer feedback, assessment; see the path in Figure 2: Instructional design, learning, knowledge, analysis, performance).

The first theme, *theory-driven approaches*, points to instructional design as a discipline that has been heavily influenced by the use of theories, models, principles, and frameworks (which belongs to the larger theme of theory-driven approaches). This finding is also consistent with the definition of the field as, "systematic procedures that need to be planned in applying the knowledge of human learning" by Gagne and Briggs [1]. Models and frameworks including ADDIE and other models guide the systematic instructional design work [4]. The prevalence of theory-driven approaches including models, frameworks, and

strategies could also be related to the emphasis on "the instruction" or "how instruction should be" as stated in previous scholarly works [7,33].

The second theme is referred to as *technology-informed designs* since it encompasses technology-related learning concepts such as online learning, computer-assisted instruction, educational technology, mobile learning along with models (such as technology acceptance model), and tools (learning management systems). Theories, models, and frameworks along with the principles of instructional design have been materialized due to the opportunities and advances provided by technology for the most part. West et al. [34] defined the field as intertwined with other fields of study including educational technologies stating, "because each discipline and each topic must be taught somehow, educational technologists exist at the crossroads to assist in designing the learning environments, instructional strategies, and technologies for teaching and learning" (p. 593). In other words, technologies play a significant role in enabling theory-informed designs [35].

The third theme that emerged was *instructional design for higher education.* As stated in Stefaniak and Xu [4], the fact that most of the studies reporting on the use of models in their design work were conducted in higher education settings suggests that the use of instructional design models could be prevalent in higher education settings. While this theme demonstrates that instructional design has a focus on HE settings, it further implies that there is more need to expand instructional design studies in K-12 and commercial settings.

The final theme that emerged was *assessment and evaluation* including words such as formative evaluation, peer assessment, peer feedback, and assessment. Evaluation can be defined as "the process of determining whether the designed instruction meets its intended goals" [36] and assessment as elements of instruction that determine whether the learning objectives are met. Both evaluation and assessment are usually parts of the systematic design process for instruction as demonstrated by the results of the SNA and text mining analyses.

In sum, it was seen that instructional design is predominantly influenced by different theoretical and conceptual approaches, benefited from emerging technologies, and targeted teaching, learning, assessment, and evaluation in the higher education context.

3.2. Learning Design

3.2.1. Time Trend Analysis of the Learning Design-Related Publications

Similar to the instructional-design related corpus, the publications indexed in the Scopus database which have the word "learning design" in their titles were analyzed. These publications included 157 articles in total including 146 articles and 11 conference papers that were published between 1982 and 2020 (Figure 4) with the first article in the research corpus published being Poppenhagen et al.'s seminal work entitled *Active Learning for Postsecondary Educators: A Study of Two Learning Designs* [37]. Similar to the instructional design time trend analysis, there is an upward trend for publications which use the term "learning design" in their titles. These articles were published over a 38-year period between 1982 and 2020, which is a trend that began earlier than instructional design-related papers. However, it was not until 2005 that the frequency of the studies increased from 3 to 19 in frequency between 2005 and 2020, which is a five-fold increase.

The time trend analysis demonstrated that the publications which have the term "learning design" in their titles increased in frequency from 2015 and onwards in comparison to instructional-design related publications which have been increasing rapidly since the early 2010s. This finding relates to how the word learning design has been replacing–and sometimes used interchangeably along with–instructional design.

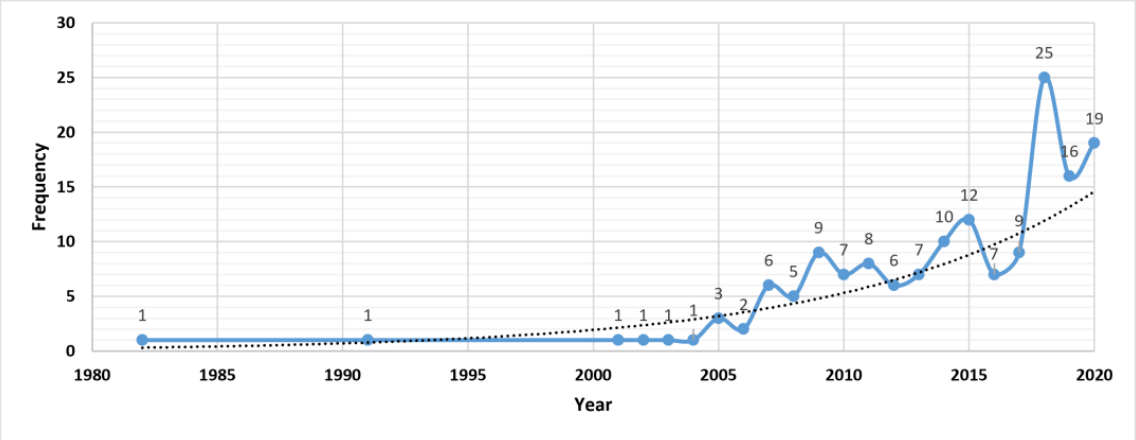

Figure 4. Time trend analysis of the learning design-related publications (Forecast curve is shown as dot line).

3.2.2. SNA and Text Mining for Learning Design

A social network analysis was conducted for the same 157 learning design-related articles in order to better understand the networked structures in terms of nodes also known as related units within this network (Figure 5). The resulting nodes were compared regarding their relative relation to the main node, which is the keyword instructional design. In addition, a lexically connected thematic map for instructional design-related papers was also generated (Figure 6). The analysis of the results from learning design-related words portrays a slightly different picture. The four themes that emerged as a result of the data analysis were: (1) design thinking- and user experience-driven approaches, (2) online learning-informed designs and online environments, (3) analytical approaches for assessment and evaluation, and (4) engagement-based learning design.

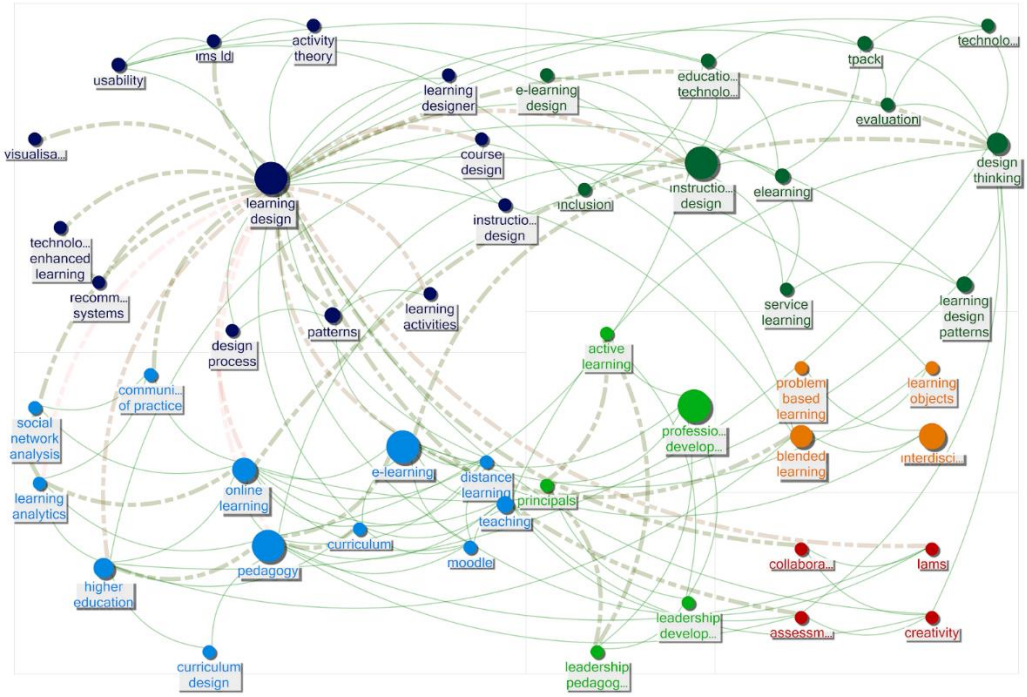

Figure 5. SNA of the keywords for learning design related papers.

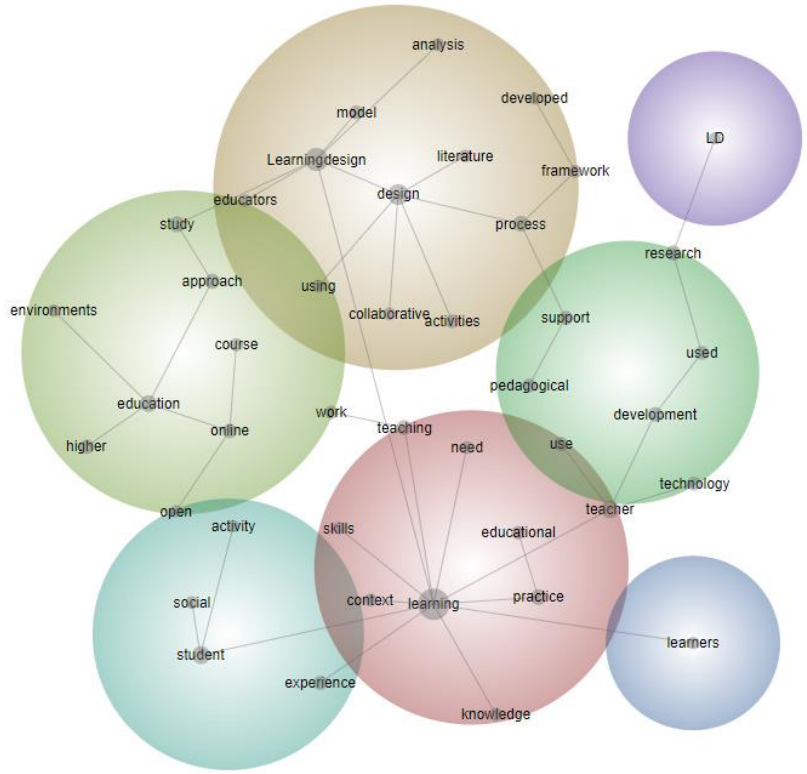

Figure 6. Lexically connected thematic map for learning design related papers.

Based on the results of the social network analysis and the thematic map for the keywords that are linked to the keyword learning design, they were combined and categorized under four main themes:

- Design thinking and user experience-driven approaches (see nodes in Figure 5: Learning design, pedagogy, design thinking, usability, learning design patterns, course design, design process; see the nodes in Figure 6: Experience, learning, students, activity, social and process, design, learning design):
- Online learning-informed designs and online environments (see nodes in Figure 5: Online learning, e-learning, distance learning, blended learning, TPACK, educational technology, technology enhanced learning, e-learning design; see path in Figure 6: open, online, education, environments):
- Analytical approaches for assessment and evaluation (see nodes in Figure 5*:* Learning analytics, assessment, evaluation, social network analysis, recommender systems, visualization; see path in Figure 6: Analysis, learning design, learning, context):
- Engagement-based learning design (see nodes in Figure 5: Creativity, active learning, communities of practice, collaboration, learning activities, problem-based learning; see path in Figure 6: collaborative, design, activities)

The findings are consistent with previous scholarly works as the emergence of learning design was marked by a shifting focus from content to a focus on learning experience [7,8] along with the increasing convergence of different yet related disciplines such as design thinking, learning experience design, newer approaches such as learning engineering and data analytics, and other learning practices including non-instructional interventions or non-traditional learning practices.

The first theme, *design thinking and user experience-driven approaches*, include keywords such as learning design, pedagogy, design thinking, usability, learning design patterns, course design, and design process along with words such as experience, learning, students, activity, social, and process. It is evident from the words such as course design, pedagogy, learning, and students that the relationship between design and learning seems prominent.

This finding is not surprising considering learning design as a field positions educational experience more as an act of design [8]. Because learning design is more design-centric, the practice could extend to different learning practices; in other words, learning can be designed creatively and learning designs can be shared in contexts including classroom learning or where other learning interventions are present. Some other related words such as design thinking and usability are more closely related to concepts such as design thinking and user experience.

The second theme, *online-learning informed designs and online environments,* includes related terms such as online learning, e-learning, distance learning, blended learning, TPACK, technology, technology enhanced learning, and e-learning design as well as terms such as open, online, education, and environments. This theme is similar to the technology-informed designs theme in instructional design analysis as the related keywords are closely related to technology with an emphasis on learning. This finding could have important implications for confirming the earlier definition and scope of learning designs as, "creating meaningful and specific learning plans by deriving from different strategies, tools (such as technologies), and resources. With the use of digital technologies, the instructional activities require even more forethought and an explicit representation of what learners and teachers will do" [38] to achieve learning outcomes, which reiterates the importance of designing for learning. Besides, this theme can be a result of the increasing use of educational technologies [39] and the emerging online learning and distance education as a part of mainstream education [40].

The third theme includes *analytical approaches for assessment and evaluation*. This theme is similar to the theme found in the analysis of instructional design-related keywords, yet there is a strong prevalence of analytical approaches in comparison to the assessment and evaluation theme in instructional design. The results suggest that the learning design field has a focus on using data, outcomes, and results to promote continuous improvement in an effort to holistically improve the learning experience—a finding which is evident from the analytical approaches of assessment and evaluation themes including keywords such as learning analytics, social network analysis, recommender systems, and visualization. Learning analytics "can help teachers interpret learner- and instructor-centric data for informing future pedagogical decisions" [41]. The introduction of analytical approaches to learning could change the landscape of educational practice in general and might also explain the increasing popularity of recently emerging sub-disciplines such as learning experience design along with its related discipline called user experience design and more recent trajectories such as learning engineering as the need to understand learner experience from a scientific and evidence-based perspective increases.

The fourth and final theme is *engagement-based learning design*, and it includes keywords such as creativity, active learning, communities of practice, collaboration, learning activities, and problem-based learning. This finding brings us back to one of the earlier definitions of learning design as, "carefully crafting the conditions for learners to enquire, explore, analyse, synthesize and collaboratively construct their knowledge from the variety of sources available to them" [42] (p. 85). In such designs for learning, a variety of pedagogical approaches might be used to create the learning conditions which put the learners, collaboration, and inquiry at the center of learning.

In brief, it can be concluded that learning design practices that place a special emphasis on design thinking by underlying the user experience, are a good fit for frequently used online learning processes, analytical approaches for assessment, and evaluation and strives for engagement-based learning design.

4. Conclusions and Future Work

The overarching goal of this bibliometric study has been to better understand the evolution of instructional design and learning design by using data visualization approaches, which are helpful in seeing different networks of connections between keywords and lexical relationships among the textual data as they relate to these two main terms (instructional

design vs. learning design) and the resulting themes (Figure 7). The results of our analyses provided visual representations to show different techniques for organizing both direct and incidental conditions affecting the process of design through which a change in an individual's knowledge, affect, or abilities can be realized. The diagrams that emerged as a result of our analysis form a metaphorical atlas of the full range of all techniques and methods available, from concrete, operational instructional interventions to contingency management and experiential explorations, that manifest the kinds of changes in learning, cognition, and performance.

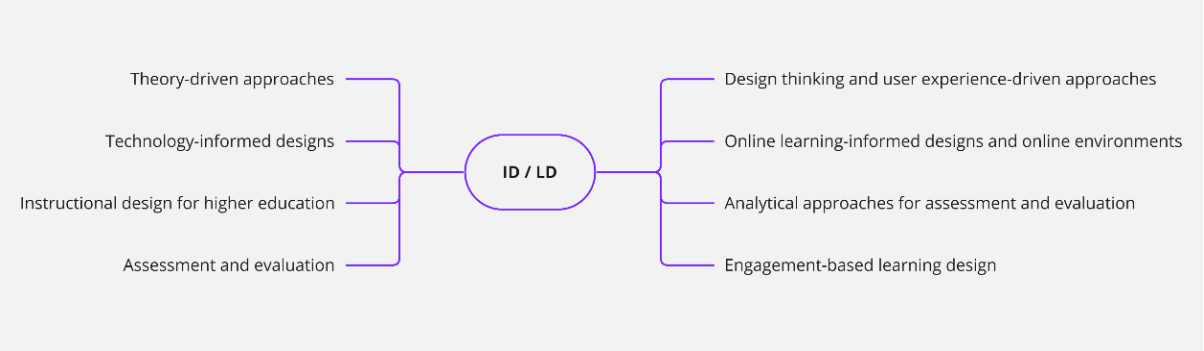

Figure 7. Emerging research themes for instructional and learning design.

It is evident that both these terms and their scopes overlap as instructional design and learning design are not necessarily two very different entities, but rather, they are terms that better represent the evolving practices and approaches they correspond to on the continuum of the learning field. In other words, both the term instructional design and learning design highlight certain practices, approaches, and directions within the same ecosystem.

The time trend analyses suggest that there is an increasing growth in the numbers of the publications on instructional design and learning design in recent years. The data reflect the historical advances in the continuum of the evolution of these terminologies. Although the idea of instructional design dates back to the 1940s, it was not until relatively recently that the field, along with its new definitions and practices, received widespread recognition.

Understanding and commenting on the trends and foundational components was facilitated by the keywords that developed with respect to instructional design and learning design. Despite the apparent similarity of the two terms in terms of their scope, the themes that arose as a result of the studies reveal prospective differences; or, more precisely, divergences as these terms continue to evolve. Rather than viewing these concepts as dichotomous, it is important to recognize that instructional design and learning design can relate to a variety of methods within the same realm of learning and instruction. One main difference between ID and LD is that instructional design seems to derive heavily from methodologies, frameworks, and systematic procedures in the design process, whereas in learning design, the "design" aspect is prioritized as learning can be designed in versatile ways, and the focus is more on the "experience" of the learners. Based on the data from the SNA and text-mining analysis, instructional design can be redefined as, *a systematic and often theory- and/or model-driven process of developing, assessing, and evaluating instruction that can be enhanced by the use of technology*. Likewise, learning design can be defined as, *the process of designing learning by prioritizing design, learner engagement, and experience which can be assessed and enhanced by analytical and technological approaches*.

Practitioners, educational institutions, and organizations with learning and development activities may find the current findings helpful in understanding the various definitions and applying what these definitions entail. Given the aforementioned redefinitions of instructional design and learning design, it is vital and beneficial to distinguish the contexts in which these two major words are utilized. Instructional design can be applied

to situations where the learning should be systematically designed based on learning objectives drawing from a set of principles, theories, and approaches in general. As the findings and the recent literature suggest [4], the concept of instructional design is more prevalent in higher education. The systematic aspect of instructional design, which may be better implemented in higher education curricula and organizational settings, may be one of the explanations for this conclusion. It might be the case that designing instruction and complex curricula such as university curricula and organizational training could be categorized under instructional design practices, whereas learning design can be more flexible in terms of its scale and the learning environment—the applications could vary from small scale learning contexts such as classroom learning to even larger designs such as designing learning for immersive environments such as, but not limited to, virtual learning environments or K12 learning environments.

As the focus on complex learning and learning environments grows, access to student data is becoming more available [7], which also explains the emergence of analytical learning approaches such as learning analytics. This study signifies a paradigm shift in our profession regarding the knowledge of how learners experience or should experience learning, not just from a subjective or observation-based perspective, but also from a data-based perspective. As this trend continues, sub-disciplines of learning design such as learning engineering and learning experience design could become more prevalent where learner experience and data connection play a crucial role in decision-making processes about the design of learning.

Through data mining and visualization techniques, the authors of this research aimed to produce the first comprehensive ecosystem map of what we need to navigate through the instructional and learning design metaverse. The findings as they relate to the two keywords, instructional design and learning design, have important implications for understanding these keywords and more importantly the instructional and learning design fields; however, these findings should be supported by future design work or epistemological studies to validate the methodological snapshots that emerged in this study.

Author Contributions: B.S.: Conceptualization, Formal analysis, Writing—original draft, Writing—review & editing; A.B.: Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Software, Visualization, Writing—original draft, Writing—review & editing; E.W.: Conceptualization, Writing—original draft, Writing—review & editing. All authors have read and agreed to the published version of the manuscript.

Funding: This paper is supported by Anadolu University under grant Nos. 2106E084 and 2207E099.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

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