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ARTICLE

Intellectual roots of distance education: a progressive knowledge domain analysis

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ABSTRACT

Distance education (DE) is a constantly evolving and advancing field, and as such, its intellectual network and dynamics need to be investigated and explored. In this regard, this study reviewed a total of 1685 articles and 51,940 references through social network analysis for a bibliometric examination of the DE field. The findings indicate that DE is an interdisciplinary field and part of mainstream education. The progressive knowledge domain analysis revealed that the intellectual roots of DE stem from generic social learning theories, after which DE-related theories began to emerge following the foundation of open universities. The research concludes that there was a paradigm shift that resulted from developments in online networked technologies in the 2000s, at which time DE started to gradually evolve into sixth generation ubiquitous DE.

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distance education; open and distance learning; online networked learning; intellectual network; bibliographic analysis

Introduction

As a constantly evolving and advancing field, distance education (DE) benefits from online and offline technologies in its effort to provide the most effective working solutions for learners who are separated in time and space from facilitators, learners, and learning resources; thus, DE is a pragmatic approach to learning. The fact that DE employs online and offline technologies gives DE a multidimensional and multilayered ecology, with overlapping and intersecting boundaries, where interaction with living and nonliving entities has significant importance. Such a view requires further understanding DE within this context and taking a critical position to identify what has been created, in intellectual terms, how the field is influenced, and how the field should move forward. Addressing these issues is vital, if the goal is to contribute to the field, feed its sustainability, reinforce its existing pillars, or even perhaps forge new pillars, in order to respond to and reflect the paradigm shifts that have been occurring and evolving. In this sense, there is a need to identify, track, and map the intellectual network of DE, an effort that this article primarily aims to undertake.

Journals and articles function as key resources for the diffusion of scientific knowledge. Published articles, in fact, serve as indicators of the intellectual state of any given branch of knowledge and can be further used to identify the epistemic status of any discipline.

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From a social interaction perspective, it can further be claimed that articles are social nodes, insofar as they connect to each other through citations. In this context, citation networks can be seen as social networks, facilitating relationships that are not coincidental by nature, but rather, purposeful acts. Citing and being cited are intellectual dynamics and can be considered as indicators of constant change, development, and progress in intellectual ecologies as well as indicators of the evolution of knowledge. Citing articles and cited articles are linked to each other through invisible ties, and they collaboratively and collectively build an intellectual community that can be referred to as a living network, structure, or an ecology. If these invisible intellectual ecologies can be made visible, and hidden patterns in meta-narratives can be revealed, then we can systematically investigate these ecologies and identify, map, and report the roots of these intellectual ecologies, how they evolved, and what affected their evolution, and thereby make projections on where they are heading.

**Literature review**

Technology, pedagogy, and all other socioeconomic developments have a symbiotic relationship with DE research and over time form the nature of its intellectual ecology. Therefore, the nature of the DE field requires that a systematic approach, like examining its intellectual ecology, be taken to understanding it. Such an approach can provide insights into the changing trends and patterns, which would help the shareholders of DE field to better integrate theory and practice, and thus, advance the DE field. In this regard, there have been many attempts to identify research trends and patterns in the field of DE (Berge & Mrozowski, 2001; Bozkurt et al., 2015; Lee, Driscoll, & Nelson, 2004; Zawacki-Richter, Bäcker, & Vogt, 2009; Zawacki-Richter & Naidu, 2016). In highlighting DE’s pragmatic nature, these studies concluded that while pedagogical themes had once dominated the DE field (Berge & Mrozowski, 2001), after the 2000s there was a shift from pedagogy-related research themes to technology-related research themes (Bozkurt et al., 2015; Lee et al., 2004; Zawacki-Richter et al., 2009; Zawacki-Richter & Naidu, 2016). The findings from these studies are in line with the vision of McLuhan (1964), who made interpretations about the symbiotic relation of technology, humankind, and society that have emerged as a result of technological developments and the reflections of these developments on every aspect of human life, including education. Similarly, Anderson and Dron (2011), in their study on DE, drew attention to technological and pedagogical determinism, and Anderson (2009) further stated that the two are intertwined in a dance: “The technology sets the beat and the timing; the pedagogy defines the moves” (p. 2). In brief, it can be argued that technology and pedagogy shaped DE, and, in turn, DE reshaped the way we teach and learn.

In addition to the above-cited systematic review studies covering research trends and patterns in DE, bibliographic reviews of DE research have also been conducted (Bishop & Spake, 2003; Bozkurt et al., 2015; Gomes & Barbosa, 2018; Martínez & Anderson, 2015; Zawacki-Richter & Anderson, 2011; Zawacki-Richter, Anderson, & Tuncay, 2010). For instance, Martínez and Anderson (2015), in highlighting the eclectic nature of the research in the DE field, reported that the Pareto principle has the ability to explain citation patterns in DE research. Moreover, Bishop and Spake (2003) reported a list of publications to assist “policy-makers in their attempt to develop quality distance education programs” (p. 372), while
Bozkurt et al. (2015) presented the most cited references to highlight the significant publications in the field of DE and provide a guide to researchers; yet, it was not the intention of these studies to analyze patterns in depth. In conducting a bibliometric analysis of scholarly DE journals, Zawacki-Richter and Anderson (2011) explored core and peripheral journals and their impact and significance in the field, while Zawacki-Richter et al. (2010), who compared scholarly DE journals, concluded that there was little difference in terms of the number of citations in open access journals and the number in copyright protected journals. Lastly, Gomes and Barbosa (2018) examined the DE co-authorship network and reported that the number of collaborative articles had tended to increase and that there was a pattern indicating DE to be an international and cross-disciplinary field.

Although the field of DE has been explored by conducting systematic reviews to identify research trends, social network analysis (SNA), and bibliometric analysis to reveal hidden patterns, none of these studies explored the intellectual network and dynamics of the field through a progressive knowledge domain analysis or examined it with a holistic, longitudinal view. In this regard, this study intends to contribute to the field of DE by conducting such an analysis.

**Purpose of the research**

Considering the above thoughts, the main purpose of this study was to investigate and explore the intellectual network and dynamics of the DE field. In this context, the study sought to answers the following research questions. What are the patterns within the field of DE in:

- interdisciplinary outlook;
- pivotal contributions and turning points that indicate progress and evolution;
- temporal analysis of the articles cited and the shifting attention of the scholarly community;
- keyword network of published articles?

**Theoretical backgrounds**

This study benefits from two theoretical approaches to interpret the research findings. The first is Kuhn’s (2012) structure of scientific revolutions and the second is Shneider’s (2009) four-stage model of a scientific discipline. According to Kuhn’s structure of scientific revolutions, science advances through iterative loops, and once the loop is broken, a paradigm shift occurs in the field and leads to scientific revolutions. This theory includes three distinct stages: normal science, crises, and revolutions. At the normal science stage, the field is dominated by a single paradigm and there is a consensus about the direction of research. At the crisis stage, researchers challenge the existing established research paradigms. Finally, at the revolutionary stage, researchers challenge the existing established research paradigms. When the final stage becomes the default paradigm, the revolutionary stage transforms back into the normal stage, and the loop then repeats itself. According to Shneider’s four-stage model, there are four distinct evolutionary stages. The first stage involves the emergence of the field with its own language, definitions, and terminology. The second stage involves
the development of “all the major techniques, enabling the language of the new science to be useful and sophisticated enough to describe a broader spectrum of phenomena” (p. 219). The developments in this stage are usually explored after their first appearance. In the third stage, researchers “re-describe their subject matter in the language developed during the second evolutionary stage, and this facilitates new insights, new answers, and new questions” (p. 220). It is at this stage that detailed and precise research findings are expected. Most of the original ideas and groundbreaking new discoveries are made at this stage. In the fourth stage, research topics are applied to “previously generated knowledge for practical purposes” and the discipline transforms into a default area of everyday life (p. 220). This study uses these theoretical backgrounds to explain the current state of DE.

Methodology

Research method and design

The study used SNA (Hansen, Shneiderman, & Smith, 2010) within the data mining and analytics methodology (Grinstein & Wierse, 2002) to analyze the bibliometric data from the four sampled academic journals (see Table 1). In SNA, networks are reported through sociograms, where nodes are presented as points and ties are represented as lines to conceptualize and to analyze them. In addition to visual analysis of the networks, SNA provides different numeric metrics to allow researchers to make further interpretations and triangulate the research findings. In the case of this study, the nodes were journals, authors, and references, while the lines were used to indicate the relationship among them. In this context, SNA, as a research model used within the framework of the data mining and analytics methodology, was considered to be a robust research approach to analyze the research sample.

Inclusion criteria and sampling

The inclusion criteria used for the selection of the articles in this study required that they have a strong focus on DE, be published in English, indexed in Scopus, and be in the 50% percentile (quartile 1/quartile 2 slice), and have a value of SNIP ≥ 1 and SJR ≥ 0.5 as of 2018 (Table 1). The sample used in this study is consistent with the sample of journals reported in previous studies (Gomes & Barbosa, 2018; Zawacki-Richter & Anderson, 2011; Zawacki-Richter et al., 2010) and is thought to be representative. Four double blind peer-reviewed

Table 1. Sampled journals.

<table>
<thead>
<tr>
<th>Journal</th>
<th>Rank</th>
<th>Percentile</th>
<th>Quartile</th>
<th>Cite score</th>
<th>SNIP*</th>
<th>SJR**</th>
</tr>
</thead>
<tbody>
<tr>
<td>International Review of Research in Open and Distributed Learning</td>
<td>56 out of 979 (Education)</td>
<td>94</td>
<td>Q1</td>
<td>2.73</td>
<td>2.090</td>
<td>1.256</td>
</tr>
<tr>
<td>Distance Education</td>
<td>150 out of 979 (Education)</td>
<td>84</td>
<td>Q1</td>
<td>1.75</td>
<td>1.299</td>
<td>0.696</td>
</tr>
<tr>
<td>American Journal of Distance Education</td>
<td>421 out of 979 (Education)</td>
<td>56</td>
<td>Q2</td>
<td>0.84</td>
<td>1.089</td>
<td>0.714</td>
</tr>
<tr>
<td>Open Learning: The Journal of Open, Distance and e-Learning</td>
<td>365 out of 979 (Education)</td>
<td>62</td>
<td>Q2</td>
<td>0.95</td>
<td>1.103</td>
<td>0.577</td>
</tr>
</tbody>
</table>

Note: *SNIP: Source normalized impact per paper. **SJR: SCImago journal rank.
DE journals that met the inclusion criteria were selected for this analysis. These journals are *The International Review of Research in Open and Distributed Learning* (http://www.irrodl.org/index.php/irrodl), *Distance Education* (https://www.tandfonline.com/toc/cdie20/current), *American Journal of Distance Education* (https://www.tandfonline.com/toc/hajd20/current), and *Open Learning: The Journal of Open, Distance and e-Learning* (https://www.tandfonline.com/toc/copl20/current) (Table 1).

This study used two sets of samples. For the SNA-based bibliometric analysis, a total of 1685 articles, published in the four sampled journals (see Table 1), and 51,940 references (e.g., articles, books, book chapters, proceedings) in published articles from 1916 to 2018, were included in the data set. It should also be noted that the starting point, 1916, emerged by itself after analyzing the references in the published articles of the four sampled journals. For time zone and timeline analysis, the top articles per year were analyzed, as well as 979 references (nodes) and 5098 co-citation links (ties). For keyword analysis, 102 of 3255 keywords were included in the analysis. The keywords selected had to have occurred at least five times.

**Strengths and limitations**

The strength of the study lies in its methodology and scope. First of all, the study contributes to the body of knowledge on this subject by exploring deeper layers of the intellectual network and further provides a progressive knowledge domain analysis of the DE intellectual network. In this regard, the current study can serve as a basis for future studies. Second, in contrast to the use of only the first author in traditional co-citation analysis, this study, as suggested by Schneider, Larsen, and Ingwersen (2009), provides all-author co-citation patterns to secure stronger, more comprehensive patterns of co-citation. Third, innovative visual analytic approaches assist researchers in interpreting the findings from large volumes of data by lessening the cognitive load and further help to recognize complex patterns to better understand the field and capture the overall outlook of the intellectual network. Finally, the data included in the research corpus for analysis are free from researcher bias, as these data were analyzed through machine-based algorithms.

There are, however, some limitations as well. First, though the sample is composed of a large volume of data and is representative, it still provides only a partial view. That is, the intellectual network provided by other journals indexed in different databases could provide additional valuable research findings. Second, the research acknowledges that the bibliometric analysis of other type of publications (e.g., proceedings, books, reports) would provide a complementary view. Third, the data that constituted the research corpus are limited to those provided by Scopus. Fourth, the articles sampled for the analysis are in English, which can be considered as an obstacle to achieving a pluralistic view. Finally, it should be noted that the articles published in the four journals might have been influenced by the journals’ scope, attitudes of the reviewers, and the preferences and gatekeeping role of the editors and the editorial board.
Findings and discussion

Dual map overlays: interdisciplinarity

The whole is the sum of its parts and the purpose of dual map overlay is to visualize the interaction of disciplinary regions through a comparative view on a global scale, making it possible to reveal the disciplinary structure of any field. On these grounds, dual map overlays provide the citing and cited bases in a single frame to identify collective citation patterns (Chen & Leydesdorff, 2014). To achieve this goal, a base map illustrated with the visualization of 10,000 high-impact journals are clustered according to their discipline (Zhu, Kim, & Chen, 2017).

Disciplinary fields have a tendency to cite publications within their own fields of discipline or neighboring disciplinary fields (Chen, Arsenault, Gingras, & Larivière, 2015), while interdisciplinary fields have a tendency to cite within their own fields and many other disciplines (Larivière & Gingras, 2010), which results in a dispersed citation pattern. The visual analysis of the four journals (Figure 1), as depicted with the origin base on the left side and target base on the right side, with red arches representing the relationships, demonstrates a dispersed pattern, which shows that DE is an interdisciplinary field. This finding confirms the results of the studies by Xiangyi (2011) and Gomes and Barbosa (2018), who reported that DE is characterized as an interdisciplinary and multidisciplinary field.

Being an interdisciplinary field means that issues have been explained from different angles, and that the field is more complex and sophisticated than mono-disciplinary fields (Veletsianos & Shepherdson, 2015). Moreover, the interdisciplinary nature of any field enables bridges to be built between different disciplines and integrates and involves multiple perspectives. Though the interdisciplinary nature of DE can be interpreted as an indicator of diversity in theory and practice and collaboration among other disciplines, this finding further indicates that DE has already built links to other scientific disciplines and has become a part of mainstream education.

However, further questions ought to be raised about the interdisciplinary nature of DE and its mainstreaming. Referring to Wedemeyer’s (1981) “learning at the back door” metaphor, Naidu (2016) stated that DE “grew out of the need to address a socioeconomic and political agenda and largely because conventional campus-based educational practices could not meet the increasing demand for access to educational opportunity” (p. 94). As such, DE opens up doors for those who are unable to access conventional educational opportunities.

The current status of DE as being a part of mainstream education has both opportunities and threats. As an opportunity, this transformation into mainstreaming requires change, adaptation, and evolution in theory and practice, and thus is a catalyst for the advancement of DE as a discipline. However, as a threat, mainstreaming might have some side effects. For instance, the mainstreaming of DE could mean that the founding ideas and core values of DE are assimilated into traditional education. The emergence of diploma mills, Fordist educational processes, and capitalization of education are examples of this kind of assimilation. In many of these cases, the actual agenda for benefiting from DE is not to open many doors, but rather, to reach a wider audience for profit purposes. Distance educators should approach the case with caution and adopt strategies to open many back or front doors and
remember that DE was originally meant to provide educational opportunities for those who wouldn’t otherwise be capable of opening any doors.

**Pivotal contributions and turning points**

Citing and being cited are not coincidental acts, but rather, purposeful and intentional. When articles are cited, they, in fact, emerge democratically, with each citation functioning like a vote. When a scholarly article emerges as pivotal, it is, in fact, an outcome of a collective citation behavior. A scholarly article’s impact in the field is defined by other
articles, and the collectively defined impact has the ability to shape the field, and further become an intellectual milestone as a result of the turning points from the progress and evolution of the discipline. In this context, identifying pivotal contributions would provide researchers insight into developments in the field and enable them to mitigate the complexity of sense-making and thus see the bigger picture.

Pivotal contributions in an intellectual landscape can stem from internal or external reasons. The internal reasons include new discoveries or contributions that fill a gap or provide answers sought by researchers, while the external reasons include populist discourse, researchers with high page rank scores, or articles positioned in central, strategic points in the intellectual ecology (C. Chen, 2006). Pivotal articles are thought to be significant, and their significance is defined as a result of sequential processes, and they, therefore, indicate what the turning points are and how the field is advancing (Chen et al., 2006).

In examining the publications cited in the sampled journals from the period between 1916 and 2018, this analysis covers more than a century. Four pivotal contributions from six publications were identified by calculating citation frequency and betweenness centrality scores (Figure 2). In other words, the articles that were most cited and found to bridge the intellectual network were considered as pivotal contributions.

First, though it is not specific to the field, it is clear how the views of Vygotsky (1978) have become one of the turning points for DE. Accordingly, he claimed that “learning is a necessary and universal aspect of the process of developing a culturally organized, specifically human psychological function” (p. 90), which highlighted the importance of social interaction, culture, and language in cognitive development. He further introduced other critical concepts in his seminal works, like the concepts of zone of proximal development and scaffolding. Vygotsky’s contribution affected not only DE but also

Figure 2. Pivotal contributions and turning points in a time zone view.
education in general. From the view of DE, his contribution is related to pedagogical and andragogical aspects and directly affected the way DE is practiced and how both learning and instructional design activities are carried out.

The second pivotal contribution was derived from two significant publications by Moore. Moore (1989) redefined interaction in the context of DE as learner-learner, learner-instructor, and learner-content interaction. In another pivotal contribution, Moore and Kearsley (1996), in their book, explained DE through a systems perspective and introduced research-based principles for DE processes. The third pivotal contribution comes from Wenger (1998), who explained communities of practice (CoP) and suggested that meaningful learning occurs through social practice, participation, and interaction.

The fourth and final pivotal contribution and the one with the greatest impact was made by Garrison, Anderson, and Archer (2000, 2001), who introduced the community of inquiry (CoI) model and its three elements: cognitive presence, social presence, and teaching presence. The value of the CoI lies in its potential to provide effective learning experiences in computer-based, online educational spaces.

It is thought to be significant that pivotal contributions that emerge as turning points are publications that have stronger theoretical roots, rather than publications covering so-called innovative technologies. This finding, again, reminds us that technology is a means rather than an end. These innovative technologies are supposed to change DE and the nature of learning. However, the collective discourse that has echoed for more than a century portrays DE as a pragmatist field, one that benefits from technology to lessen limitations in DE processes and to provide working solutions for those who pursue knowledge. The analysis further reveals that DE uses technology as a means to provide effective, efficient, and sustainable learning experiences and strives to provide interaction and communication by acknowledging the importance of social context. Therefore, as an interdisciplinary field, DE sees learning through the lenses of social learning, CoP, the CoI, and other similar theoretical underpinnings. Confirming this finding and as a reminder, Anderson (2008) stated that theories are significant for gaining deeper insights regarding the research in question and for transforming the knowledge from one context to another. Similarly, grounding their statement on Kant’s saying “theory without practice is empty; practice without theory is blind,” Morrison and van der Werf (2012, p. 399) noted that “there is a symbiosis between theory and practice, and, for educational research, they cannot flourish without each other, even though they may have difficulty in living both with and without each other.”

Temporal patterns in distance education and the shifting attention of the intellectual community

By analyzing 54,940 references used in 1685 articles in four sampled journals, temporal patterns were identified in a timeline visualization. Publications were presented visually as circles and their sizes were defined by their citation count and betweenness centrality. The relationship between citing and cited is visualized with arcs. The publications were laid out horizontally according to their publication dates and clustered according to co-occurrence of the words in the abstracts and their lexical relationships.

Timeline visualization provides a view of the progress of any field. In the case of the present study, the publications are depicted horizontally, while the clusters are displayed vertically (Figure 3). Timeline visualization is an effective approach for examining the
shifting attention of the intellectual network and for identifying the paradigm shifts that have occurred over time (Chen, 2017).

The intellectual roots of DE date back to two of Dewey’s *magnum opus* works (1916, 1938). By the late 1970s, publications on social learning by Bandura (1977) and Vygotsky (1978) had a great impact on the DE field. By the 1980s, attention shifted from generic learning theories to DE-related theories. For instance, Moore’s (1989) work on interaction types and Davis’ (1989) work on the technology acceptance model stand as significant contributions. By the 1990s, another significant shift occurred, in terms of the learning community formation and vital processes in these communities. Accordingly, Lave and Wenger (1991) and Wenger (1998) highlighted the importance of domain (shared interest), community (collective learning), and practice (engagement and interaction) in learning processes. In fact, from earlier times to the 2000s, it can be observed that DE has strived to build a basis for social learning and extend its arguments with technology-enhanced solutions, which became more visible after the 2000s.

Starting from the 1970s, and especially from 1980 onwards, an increase in density in the intellectual network of DE can be observed. As argued by Weller, Jordan, DeVries, and Rolfe (2018), DE becomes more visible by the 1980s because of the emergence of the open university phenomenon (e.g., the University of South Africa in 1946, the Open University of the United Kingdom in 1969, and Anadolu University in 1982), which is in line with Tait’s (2018) argument that open universities were a catalyst for the development and acceptance of DE.

In the 2000s, with the advent of the new millennium, the revolutionary digital knowledge age led to an increase in capacity that arose from the opportunities provided by information and communication technologies, online networked spaces, and ubiquitous

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*Figure 3. Temporal patterns and shifting attention through timeline visualization (only first authors are shown).*
computing. The analysis indicates a burst in the new millennium, starting with the seminal works of Garrison et al. (2000, 2001), who introduced the CoI. The notion of the CoI, which was originally meant to be “a tool for the use of computer mediated communication (CMC) and computer conferencing in supporting an educational experience” (Garrison et al., 2000, p. 87), provided a clear walkthrough for meaningful learning experiences via online DE, and there has been a continuing interest in the CoI and online implementations. In this context, Picciano’s (2002) work regarding quality and quantity of web-based online courses; Venkatesh, Morris, Davis, and Davis (2003) work on acceptance and use of technology; Means, Toyama, Murphy, Bakia, and Jones (2009) review of online learning; Bernard et al.’s (2009) justification for Moore’s (1989) interaction types; Braun’s (2008) article regarding online graduate students; and Dron’s (2007) book on e-learning can be counted as strong proofs for this interest in online implementations, as identified in the timeline visualization.

The timeline analysis indicates that DE witnessed a paradigm shift resulting from the capacity increase derived from technological developments. With online technologies, distance in time and space has become of minimal importance, which was an expected outcome, and the field has since endeavored to reduce transactional, in other words, psychological distance. It is also worth mentioning that the changing attention shift in the 2000s aligns with the explanations provided in Kuhn’s (2012) structure of scientific revolutions. Therefore, it is expected that the revolutionary stage, that is, online networked DE, will transform its cycle, and when this happens online networked practices will be the default for DE. Similarly, the blast in citation pattern and its scope (online and networked practices) indicates that DE is in the third stage of Schneider’s (2009) four-stage model and will be exposed to novel initiatives due to the capacity increase resulting from constantly advancing online networked technological developments.

Castells (2004) vision for a networked society became real by the 2000s. The repercussions of the networked society can be observed in every aspect of our lives, including DE. For instance, arguments on networked learning and connectivism were articulated by Siemens (2004) and Downes (2008). Kop (2011) explored the idea of massive open online courses (MOOCs) from the perspective of connectivism. Similarly, Daniel (2012), Liyanagunawardena, Adams, and Williams (2013), and Yuan and Powell (2013) reviewed the MOOC phenomenon. Finally Allen and Seaman (2013, 2016) evaluation of online learning and its impact on both educational and marketing potentials called attention to and demonstrated the shifting interest to online and networked DE.

It is clear that online networked technologies have changed and shaped DE practices. MOOCs, for instance, have become a popular research topic. Expectedly, MOOCs, as well as pedagogical perspectives (e.g., connectivism and rhizomatic learning), emerged as a result of the efforts to better understand networked learning processes. In line with these developments in the field of DE, it is also evident that online learning has continued to draw attention with the shift from online to networked DE. In this interpretation, it should be noted that online learning emphasizes the facilitation of learning through the Internet and computers (e.g., use of content or learning management systems), while networked learning emphasizes making connections, and building online learning communities on the Web (e.g., use of collaborative, participatory Web tools and services, such as social media).
SNA of the keywords

In order to acquire better insights and identify research interests, this study mapped and visualized author keywords through SNA (Hansen et al., 2010) by using distance-based approaches (Van Eck & Waltman, 2014). The keywords were laid out using the grid algorithm, and weights were determined by calculating total link strength. A total of 102 keywords were tied with 811 links according to their co-occurrences, and total link strength (TLS) was 1136.

The analysis showed that DE, online learning, eLearning, open educational resources, higher education, distance learning, MOOCs and open education were the central keywords, having a sum of 736 TLS, which constitutes nearly half of the network. These keywords were followed by mobile learning, open and distance learning, online education, interaction, motivation, collaboration, blended learning, instructional design, and online teaching (See Figure 4). Accordingly, the keyword analysis indicated there to be four major themes, which were determined based on betweenness centrality scores, TLS, and clusters defined according to co-occurrence of the keywords (see Figure 4). These were (1) increasing online, networked practices, (2) constantly changing and evolving definitions, (3) higher education-centric focus, and (4) the powerful influence of openness initiatives.

The first theme is about the dominance of online networked practices. This finding confirms what Larreamendy-Joerns and Leinhardt (2006) argued to be the case, namely the growing tendency toward online networked DE. Currently, it is seen that online has become the new

Figure 4. Keyword network for DE-related terms.
normal, and that DE orbits around online practices. In this context, it may be said that DE has been evolving into its fifth generation (Moore & Kearsley, 1996; Taylor, 2001), that is, online practices (Moore & Kearsley, 1996) and advancing toward its sixth generation, that is, ubiquitous DE, which is supposed to be more accessible and flexible. Secondly, referring to ubiquitous DE, the finding indicates that DE is by nature flexible and open, and this is a valid characteristic, not only for its core visions but also for its definitions.

The second theme is about constantly changing and evolving definitions. Weller et al. (2018) argued that terms like DE, open education, and open and distance learning are historically intersecting with one another, and as suggested by Bozkurt (2019), the field is constantly evolving, and therefore there is a need to keep the definition of “DE up-to-date to better explain the needs of the global [open, flexible, and distance] teaching and learning ecosystem” (p. 252).

In the third theme, it is seen that higher education is the focus of DE. Though this can be interpreted as a promising theme, what has been revealed is less emphasis given DE in K–12 areas. Considering that DE is a part of mainstreaming education, even at K–12 levels (Rice, 2006), the research focus is mostly on higher education. Students have been enrolling in DE programs at an increasing rate (Seaman, Allen, & Seaman, 2018), and the marketization of education has emerged as a potential problem (Bartlett, Frederick, Gulbrandsen, & Murillo, 2002; Natale & Doran, 2012).

For the fourth and final theme, it is clear how ideas related to the openness philosophy shape and influence DE. From further analysis of the keyword network, it was seen that openness-related keywords, such as open educational resources, open educational practices, open access, and open education, are linked to certain keywords, such as barriers, policy, culture, and sustainability. This analysis further justifies that the openness movement is, in fact, a broader concept and an umbrella term. However, it should be noted that focusing only on access issues hinders the openness movement from revealing its real potential. This interpretation is in line with the statements made by Knox (2013, p. 21), who claimed that “access to online material is the principal concern of the open education movement” and Naidu (2017, p. 2), who argued that the core principles of “distance education remain openness and flexibility, which we see as value principles, much like we see diversity, equity or equality in education and society more broadly.”

Conclusions and implications for future research

This research examined the intellectual roots and structure of DE through a progressive knowledge domain analysis. By sampling articles published in four prominent DE journals and mapping more than 50,000 references, the research findings demonstrated that DE is an interdisciplinary and multidisciplinary field and that, therefore, understanding the dynamics and nature of DE is a challenging and complex issue.

Dual map overlay visualization (Figure 1) indicated that the field of DE is considered part of mainstream education because of its highly dense and integrated links with other disciplines. In this analysis, however, it is noted that mainstreaming presents opportunities and threats. While mainstreaming can be a change agent, it can, if not approached with caution, assimilate DE and turn it into a marketing tool by ignoring its core values and fundamentals, such as equity in education, social justice, the liberation of knowledge, democratization of education, and the removal of barriers between learners and learning sources.
In the time zone analysis (Figure 2), pivotal contributions and the transition to theoretical publications further revealed that after going from generic educational theories to DE-related theories focusing on online learning environments, the field advanced and generated its own theories to better interpret the DE ecology. The findings also demonstrated that DE is a pragmatic field and sees technological developments as a means of providing meaningful DE experiences.

The timeline analysis (Figure 3) demonstrated that the intellectual roots of DE date back to the early 1900s when the social learning idea was being explored, and in the 1980s, DE further developed as a result of the establishment of open universities across the world, before reaching its peak in the new millennium.

By the 2000s, a paradigm shift had occurred and the focus on DE shifts from online to networked DE. The SNA of the keywords (Figure 4) revealed four major themes: increasing online, networked practices; constantly changing and evolving definitions; higher education-centric focus; and the powerful influence of openness initiatives.

According to Kuhn’s (2012) structure of scientific revolutions, from 2000 onwards, DE has been at the revolutionary stage, where new paradigms replace already existing ones and provide new perspectives. Accordingly, DE is fully experiencing this stage as a result of the pace of knowledge production in the digital knowledge age, which indicates that DE will complete its loop and online networked DE will be the default in the near future, bringing about the sixth-generation DE. In terms of Shneider’s (2009) four-stage model, DE is nearing the close of the end of the third stage, where the DE field is exposed to new developments and therefore needs to adapt itself accordingly. This means that DE will witness innovative, groundbreaking ideas and will put them into practice, leading the way to the fourth stage in Shneider’s four-stage model.

The progress of the field of DE has been happening faster as a consequence of the capacity increase, and this requires us to develop strategies and take positions to defend and advance the field in time for a change. In this sense, the findings of this research suggest the following for future research implications. First, in order to prevent the field from experiencing the side effects of the mainstreaming and technological lure, the core values and founding ideas of DE should serve as a guide for going in the right direction and thereby prevent DE from losing its path. Second, at a time when paradigm shifts have been happening, it is the responsibility of the researchers, educators, and thinkers to keep the definitions up to date and fine tune them when necessary. Such a position is essential for ensuring a sustainable DE ecology and for providing a clear vision for those who operate in the DE ecology. Finally, even though all these changes, shifts, and transformations are exciting, it should be remembered that all of these are not happening at one and the same time all around the globe. Realities such as information gap and the digital divide are still very alive and, therefore, it is important to keep the back door open for those who are vulnerable to these unequal developments.

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