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Review Article

Transactional distance theory in distance learning: Past, current, and future research trends

Krishnashree Achuthan [1*]
0000-0003-2618-0882

Vysakh Kani Kolil [1]
0000-0003-2035-3439

Sharanya Muthupalani [1]
0000-0001-6517-5766

Raghu Raman [2,3]
0000-0002-0851-9742

[1] Center for Cybersecurity Systems and Networks, Amrita Vishwa Vidyapeetham, Amritapuri Campus, Kollam, Kerala, INDIA
[2] Amrita School of Business, Amrita Vishwa Vidyapeetham, Amritapuri Campus, Kollam, Kerala, INDIA
[3] Amrita School of Engineering, Amrita Vishwa Vidyapeetham, Amaravati, Andhra Pradesh, INDIA
[*] Corresponding author: krishna@amrita.edu

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ABSTRACT

The accelerated adoption of distance learning in post-pandemic times has resulted in increasing research publications and review studies in a short time. This necessitates the exploration of a large corpus of academic publications for effective distance learning and learning strategies. As distance learning stakeholders have assimilated the transactional approach to understanding distance learning, transactional distance theory (TDT) is relevant to understand ways to reduce the distance between learners and educators for maximum effectiveness of distance learning. Our study applies TDT to review distance learning from a supply perspective and as a tool to ensure the improved quality of distance learning. This paper has two key contributions: we have presented evidence synthesis and conducted a foresight exercise. Following preferred reporting items for systematic reviews and meta-analyses guidelines, 275 documents published between 1994 and 2022 were identified for review. Our analysis revealed patterns, relationships, and trends in the application of TDT in various distance learning contexts. Most TDT research is conducted in social sciences (83.7%), with computer science accounting for 42.6% of the studies. The course materials' structure and design have also received considerable attention, with around 40.0% of the research focused on this area. For distance learning, studies revolve around factors such as student engagement, satisfaction, and TDT, which examine the distance between learners and instructors in various learning environments. Through systematic review and meta-analysis, we identify the three thematic areas in TDT research on distance learning. We have chartered themes on the effect of alternate design distance learning platforms on learner success, pushing the development boundaries in distance learning success through TDT, and the practical processes for designing successful distance learning courses via TDT-based pedagogical frameworks. In doing so, we streamline research in TDT and distance learning thematically and provide insight into further work. In addition, this study analyzed the relationships between sustainable development goal (SDG) and TDT literature. The co-citation analysis suggested that the strongest links were observed between education and innovation (SDG 4 and SDG 9), followed by education and gender equality (SDG 4 and SDG 5).

Keywords: bibliometrics, sustainable development, SDG, e-learning, TDT, transactional distance, science mapping

INTRODUCTION

The ubiquity of information and communication technologies has triggered a paradigm shift in the pursuit of education. The internet and its scaffolded information enabled access to resources and information. The popularity of learning, seeking information, and enhancing skills has resulted in many specialized degrees and certifications being provided online today. Distance learning encompasses various subsets (e-learning, virtual classrooms, webinars, and massive open online courses [MOOCs]) that provide different approaches and methods for delivering education remotely (Johnson, 2021; Lei & Gupta, 2010; Tzafilkou et al., 2021). Globally, distance learning is recognized as a well-accepted channel to pursue education. While this would have been inconceivable a decade ago, many regulatory agencies today consider distance learning degrees that may be pursued on a part-time or full-time mode equivalent to an on-campus full-time degree. Thus, the distance learning market has grown significantly over the past two decades. The revenue from the global online learning market is estimated to be around 15 billion dollars and is expected to grow at 6.5% CAGR (Valuate Reports, 2022). Distance learning predicts sustainable development as it provides access to the international diaspora, affordability, and flexibility about self-paced learning to millions that would otherwise have little choices in their education rigor.

Online learning is a significant part of the overarching umbrella of distance learning. The technologies supporting online learning have successfully bridged the gap in the inadequacy of traditional teaching practices to offer flexibility in learning methods and provide resources such as lecture recordings, visualizations, or animations to supplement lectures (Achuthan & Murali, 2015; Francis et al., 2016; Raman et al., 2022a). The limited availability of online learning tools is partially due to the exorbitant cost of creating interactive materials. Nevertheless, online learning can easily integrate pedagogical innovations; the outcomes depend on the appeal, usability, knowledge transfer facilitation, and overall learning experience. Unlike face-to-face classroom learning, online learning stimulates self-regulated learning, which translates to students initiating, maintaining, and sustaining the learning process.

Additionally, there are significant contributions from content quality, use of media, and course and assessment design architected to enhance memory and attention (Bai & Vu, 2022). Wong et al. (2019) review self-regulation in online learning environments and find several factors contributing to academic success, inclusive of time management, self-efficacy, and metacognition but requiring prompting to precede them. The design of an e-learning platform marries theory with practice, and multiple past studies have exhibited that design of the course might be the most important determinant of a successful online learning experience. Platforms designed with practicality and focused on contextual description have been proven to reduce transactional distance (TD). Variable designs responsive to learners and their context of learning are highly successful. In recent years, platform designers have also leaned heavily on creativity and interaction rather than the low-level immediate responses of past designs.

However, online presence, that is, the development of well-designed or technical and infrastructural support to anchor online teaching, is not a complete solution to the myriad challenges of remote instruction. The learning experience has become the holy grail of online learning. Shearer and Park (2019) envisage that an ideal online experience has pedagogical approaches with a mixture of personalized, adaptive, and transformative learning experiences, as well as instructional design strategies that are interactive and engaging. From a realistic perspective, several factors that affect adopting e-learning content and retention attitudes were investigated by Ray et al. (2022). The factors include structure rigidity, complexity level, teacher interactions, interface issues, and understanding difficulties. Over time, sustained problems cause students to drop out of these courses.

Transactional distance theory (TDT) first entered the spotlight when early studies conducted amongst small groups of learners found that dialogue was more significant in distance-format courses than traditional-format courses. However, the structure and TD remained the same. Research papers from the 1950s constantly studied distance learning compared to face-to-face instruction in this manner. Even though several comparative studies have been published periodically, their value in revealing additional data has dwindled over the years, yielding "little or no significant difference" results between various forms of instruction (Saba, 2000). Nevertheless, subsequent studies have delved into various dimensions of democratization and equalization of learning, especially as it relates to the process (such as the nature and timing of online events)

and structure (such as group size) of the online community (Lally & Barrett, 1999). In the context of computer-based distance learning, the effectiveness of structure and communications utilized by teachers and students have been researched extensively (Olsson, 2000). A review paper on distance learning education and theory drew some significant conclusions that underscore the importance of TDT in distance learning. It also showed that the theoretical advancement of the field is moving from institutional to transactional difficulties and assumptions, shedding light on an early concern with organizational and structural limits in distant learning. It questioned whether distance learning theory development would keep pace with innovations in technology and practice (Garrison, 2000).

The current interest in TDT amongst researchers is grounded on a mathematical yet intuitive relationship between learner and teacher that, if addressed correctly, should alleviate at least a few of the challenges. Some recent barriers online learners have been posed stem from more than just technological infrastructure and geospatial issues. Emergency context learning during the pandemic, for example, differs in structure and curricula from blended learning (a combination of online learning and traditional classroom learning). Being forced to learn online comes with a unique set of challenges addressed by various articles compiled in this review. Structure, dialogue, and interactivity may scaffold TDT, but these articles have analyzed the complexity of student experiences to characterize other aspects of online learning that need to be reviewed critically. From the instructors' perspective, instructors struggled to cope with varied learning capabilities (Singh et al., 2020). Due to the limited options available for peer learning, communication, establishing relationships, and expressing thoughts through online platforms, students experienced another level of alienation.

Additionally, there were no opportunities for the students to interact with one another and foster a feeling of camaraderie and community (Bhattacharya, 2020). Synthesis of literature focusing on TDT's roots in humanistic and behavioral ideology is critical to glimpse the future of online learning. The perspective of online learning has vastly shifted from structure and efficiency to quality. Adopting an organized and structured learner assistance approach using TDT-based analysis requires immediate attention, which will guarantee that virtual instruction leads to meaningful learning (Jha & Ghatak, 2023).

The United Nations sustainable development goals (SDGs) form a global development agenda for 2030, setting an ambitious path to address urgent challenges such as poverty, inequality, and climate change. Among these, SDG 4 underscores the importance of providing inclusive and equitable quality education and lifelong learning opportunities for all. In particular, TDT has the potential to significantly contribute to target 4.4 of SDG 4, aimed at increasing the number of youth and adults possessing relevant skills for employment, decent jobs, and entrepreneurship. TDT, a cornerstone of distance learning research, helps guide the design of online vocational training and education programs, making them more accessible and effective.

The post-pandemic era has witnessed a swift surge in distance learning modalities. With the escalating number of research publications and reviews on the topic within a short span, there emerges a pressing need to comprehensively explore this vast corpus of academic literature. This will enable stakeholders to unearth the most effective strategies for distance learning and discern pivotal trends. Amidst this influx of distance learning methodologies, TDT stands out as a critical lens. As stakeholders grapple with the nuances of distance learning, understanding and applying TDT can be the linchpin in bridging the gap between learners and educators. Ensuring the efficacy of distance learning pivots on our ability to minimize this 'distance'. Hence, our study, by applying TDT, not only evaluates distance learning from a supply perspective but also acts as a beacon to elevate the quality of such learning experiences. With a twofold contribution, this paper first offers an evidence synthesis, meticulously collating findings from Scopus spanning from 1994 to 2022. Second, we embark on a foresight exercise, charting the future trajectory of TDT in distance learning. Through our rigorous analysis, we have unearthed patterns, relationships, and evolving trends in the application of TDT across diverse distance learning contexts. We have zoned in on three dominant thematic areas: the impact of varied design on distance learning that includes digital and non-digital platforms vis-a-vis learner success; the evolution and potential of blending learning success within TDT framework; and actionable strategies for designing online learning courses through TDT-centric pedagogies. By weaving these themes together, our endeavor is to both consolidate current research in TDT and present directions for subsequent investigations. Moreover, our exploration delves deep into the symbiotic relationship between SDG and TDT, unearthing pivotal links between education and domains such as innovation and gender equality.

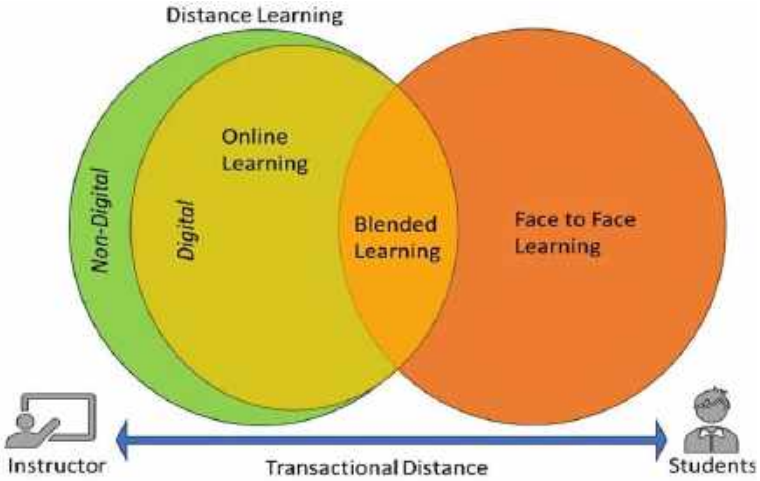

Figure 1. Focused area of research (Source: Authors)

The present study aimed to understand the following research questions:

1. What progress and discoveries have been made in TDT in the distance learning context between 1994 and 2022?
2. How well does TDT research map to SDG 4 (quality education)?
3. What are the theoretical and practical implications of TDT?
4. What are the future perspectives of TDT in the distance learning context?

This research paper aims to answer the above research questions as streamlined by three research streams identified by the literature on TDT and distance learning (**Figure 1**). In the context of this paper, we define non-digital distance learning as an educational process in which students receive instruction and educational content primarily or entirely while being separated from the instructor or fellow students by geography, time, or both (Sevnarayan, 2022). Online learning utilizes digital technologies and internet-based platforms to facilitate and support the learning process (Shahabadi & Uplane, 2015). This mode can include both synchronous and asynchronous activities. Blended learning is an educational approach that combines both online digital media with traditional classroom methods (Zilka et al., 2019). It requires the physical presence of both teacher and student, with some element of student control over time, place, path, or pace. The article encapsulates the findings of recent literature.

THEORETICAL BACKGROUND

The emergence and progression of the Internet has provided continuous benefits to various stakeholders, particularly learners, and implementers, by enabling fast and accessible training. Although the digital platform has empowered online learners throughout the Internet era by granting them greater control over the learning process and eliminating socioeconomic obstacles, the main drawback remains the issue of TD (Choudhury & Pattnaik, 2020).

TDT was proposed by Moore (1972) and identified two main factors that affect the design and delivery of online learning:

(1) structural distance, which refers to the degree of autonomy and interaction between the learner and the course materials and

(2) psychological distance, which refers to the degree of cognitive and emotional engagement of the learner with the course materials and the instructor.

Both of these factors can impact the overall learning experience and outcome. These constructs are interrelated and can impact the overall learning experience and outcome online. Moore (2018) observed that distance learning, primarily delivered via correspondence courses, was characterized by the absence of face-to-face interaction between students and instructors. Moore (2018) recognized that this absence between students and instructors caused a “distance” between the learner and the course materials.

The concept behind the "transaction" originates from Dewey (2008), and according to Boyd and Apps (1980), the transaction denotes the interaction between the environment, the people, and the patterns of behaviors in a situation. According to Moore (2018), TDT depends on the interplay between dialogue, structure, and learner autonomy as a key element. The structural distance in TDT refers to the degree of autonomy and interaction between the learner and the course materials. The TD includes the course's design and arrangement, the instructor's availability, and the degree of interaction and feedback provided.

The term "interaction" in TDT refers to the level of interaction between the student, the course materials, and the instructor. When a course has high levels of interaction, students have opportunities to engage with the course materials and the instructor through discussions, group work, and other activities. The term "structure" describes the layout and content of the course materials, the degree of arrangement within the course, and the amount of guidance provided to the learners. A high degree of structure in a course means that the course is highly organized and well-defined, with clear learning objectives and instructions. Autonomy refers to the degree of autonomy given to the learner about the course materials and the learning process. High levels of autonomy in a course mean that learners can work independently and take responsibility for their learning (Moore, 2018). The theory has been used to explain the design and delivery of online learning and to guide the development of effective online educational programs. A balance between structure, autonomy, and interaction is essential for effective online learning. TDT has also been applied to the e-learning field and has been used to explain and predict the effectiveness of e-learning. Over the years, many researchers have expanded TDT and have developed new scales.

METHODS

Search Strategy

The review was carried out, and the results were reported in accordance with preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement (Moher et al., 2009). The present study will add to the literature streams on distance learning for a large period from 1994 to 2022. The electronic database 'Scopus' was used to identify the relevant publications for the study. For bibliometric publications, Scopus is extensively utilized and recognized (Baas et al., 2020). Scopus was chosen because it offered a complete academic database with broader worldwide coverage than Web of Science, but it excluded Google Scholar's non-traditional online sources (Kulkarni et al., 2009).

Using Scopus databases, a preliminary screening was done to find the papers on TDT for this study. The following keywords (TITLE-ABS-KEY ("transactional distance theory" OR "transactional distance" OR "Moore's theory of transactional distance") AND (EXCLUDE (PUBYEAR, 2023))) were used to select the documents from Scopus. The information was collected on March 02, 2023. This process resulted in 275 documents published in English and other languages (**Figure 2**). In the identification stage, a comprehensive search was conducted in Scopus database to retrieve relevant documents from 1994 to 2022. The search criteria encompassed the title, abstract, and keywords of the documents. The search was performed on March 02, 2023, ensuring that the most up-to-date information was included in the study. In the screening stage, a total of 291 records were initially identified. However, 16 records were excluded from further analysis for reasons such as retraction, errata, or being editorial. This screening process ensured that only appropriate and relevant records were considered for the study. After the screening stage, the remaining 275 records were assessed for eligibility. This assessment involved a more detailed records evaluation based on predetermined inclusion and exclusion criteria. In the final stage, the 275 eligible records were considered for systematic review. Further, TDT publications related to SDGs were identified using Elsevier SDG mapping queries (Jayabalasingham et al., 2019).

Bibliometric Analysis

The quantitative analysis of bibliographic data is known as bibliometrics (Broadus, 1987). Bibliometric analysis has been utilized in wide range of subject areas (Cancino et al., 2017; Fernandez et al., 2018; Landström et al., 2012; Podsakoff et al., 2008; Samiee & Chabowski, 2012; Sarin et al., 2018) and examined the institutions and authors (Coupe, 2003), countries (Merigó et al., 2016), and publications regions (Bonilla et al., 2015). The bibliometric analysis of the topic is a popular technique for identifying its top trends regarding

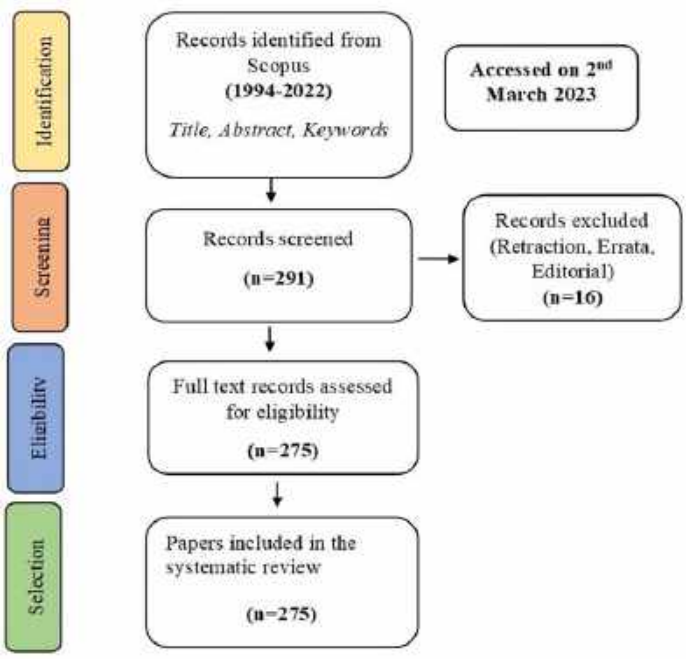

Figure 2. Selection of papers based on PRISMA statement (Source: Authors)

topics, highly cited publications, authors, organizations, and nations. Several journals have provided bibliometric analyses of article content (Di Benedetto et al., 2018; Mart'inez-López et al., 2018, 2020; Merigó et al., 2015, 2018). Through bibliographic analysis, research items in a scientific field can be categorized according to their bibliographic details, such as citations, keywords, themes, institutions, countries, authors, sources, and titles. Our study used VOSviewer software (van Eck & Waltman, 2010) to build a network for collaboration networks across countries, organizations (universities or institutes), citation analysis, co-citation analysis, and bibliographic coupling and keyword analysis. The themes were identified through keyword analysis using VOSViewer software (van Eck & Waltman, 2011). According to the literature, an article's keywords can serve as a representation of its major concepts, and themes that are focused on a particular field can be demonstrated through co-occurrence and frequency (Zong et al., 2013).

RESULTS & DISCUSSION

Progress & Discoveries of Transactional Distance Theory

The publication pattern in TDT literature is identified based on publications from 1994 to 2022. **Figure 3** demonstrates the growth in the number of publications utilizing TDT over the years. The exponential increase in the number of publications is represented by the red dotted line in **Figure 3**, emphasizing the growing interest in TDT. Even though 275 isolated research papers have been published, a serious gap is the lack of consolidated and synthesized takeaways for the future of online learning. The rise in publications from year to year clearly indicates increasing interest in the concept of TD. This exponential growth of publications signifies the simultaneous increase in the popularity of online learning, which has increased significantly since 2010 (Palvia et al., 2018). We can see the greatest number of publications in the range of 2020-2022 (total publication [TP]=83), which marked the pandemic era (Ciotti et al., 2020).

Reviewing the modifications to TDT over the years, we have charted its evolution. In **Table 1**, updates to TDT are reported, reflecting the dynamic nature of the theory. Moore (1972) first proposed TDT, focusing on structure, dialogue, and autonomy factors. Zhang (2003) added a new dimension to the theory by emphasizing the interaction between students, teachers, content, and interfaces, reflected in his TD scale. Swart et al. (2014) proposed a new version of the scale, relative proximity Theory, which focused on the relative proximity factor. The proximity study was followed by Wengrowicz et al.'s (2014) Coll-TD scale, which emphasized communication, understanding, and satisfaction. Paul et al. (2015) presented a parsimonious version of Zhang's (2003) scale of TD, further refining the theory.

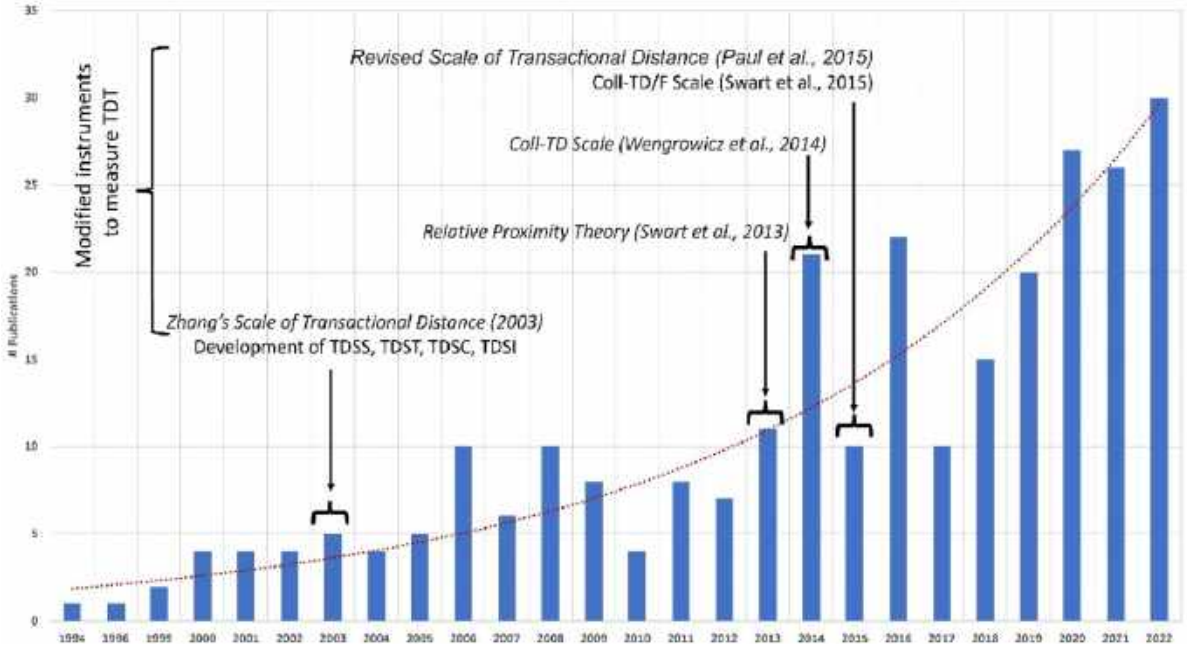

Figure 3. TPs from 1994 to 2022 (TP=275) (red dotted line represents exponential growth of publications over years) (Source: Authors)

Table 1. Revisions of transactional distance theory over years

Scale	Year	Factors	References
Moor's theory of TD	1972	Structure, dialogue, & autonomy	Moore (1972)
Zhang's scale of TD	2003	Student-student, student-teacher, student-content, & student-interface	Zhang (2003)
Relative proximity theory	2013	Relative proximity	Swart et al. (2014)
Coll-TD scale	2014	Communication, understanding, & satisfaction	Wengrowicz et al. (2014)
Revised scale of TD (parsimonious version of Zhang's scale)	2015	Student-student, student-teacher, & student-content	Paul et al. (2015)
Coll-TD/F scale	2015	Communication, understanding, & satisfaction	Swart et al. (2015)

Adding new dimensions, such as the interaction between students, teachers, content, and interfaces, has helped provide a more comprehensive understanding of TD phenomenon. The proposed scales, such as relative proximity theory and Coll-TD scale, have shifted the focus of TDT toward more factors, such as relative proximity and communication, understanding, and satisfaction, respectively. All of this reduces TD experienced by online learners.

According to the data presented in **Figure 4**, most TDT research (83.6%) is conducted in the area of social sciences, while 42.2% of the studies are carried out in computer science. Around 0.4% of TDT research is reported in nursing, neuroscience, and health professions. This disparate distribution of TDT research across subject areas invites scrutiny of its application, as it can profoundly impact diverse research areas. The gap in the application of TDT to the fields requiring evidence-based practices, such as nursing and other healthcare professions, is alarming as such fields are constantly looking for new tools to reduce TD. A recent study on a new platform to introduce hands-on learning, where physical classrooms are not possible reveals that virtual applications should have specific course and learner needs to be met through the ability to improve visualization, increase interaction between teacher and students and allow for simultaneous access of multiple teaching materials while promoting a tailored learning experience for individuals (Iwanaga et al., 2023; Nakai et al., 2022). Rigorous use of TDT across all fields will isolate factors inhibiting online learning and provide tangible solutions to reduce TD in time.

TDT is a framework for understanding and analyzing the nature of the educational experience in online learning, particularly in online learning environments. After carefully reviewing articles, we observed that interaction or communication is the most studied aspect of TDT, with around 90.0% of the research focused on this area (**Figure 5**).

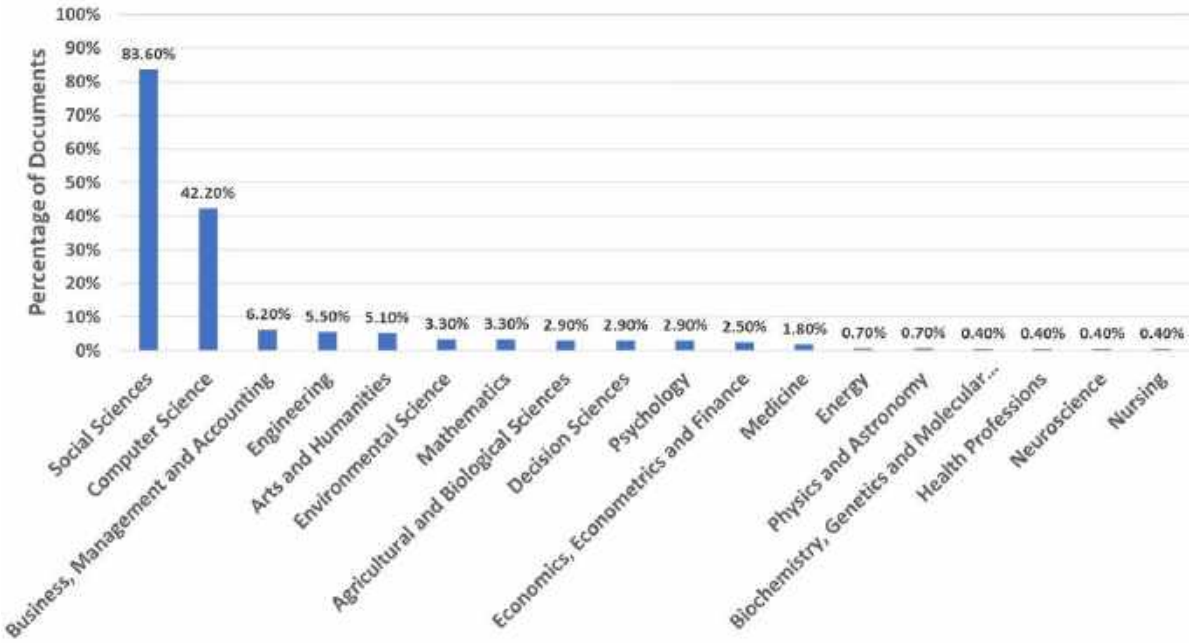

Figure 4. Distribution of documents by subject areas in TDT research (Source: Authors)

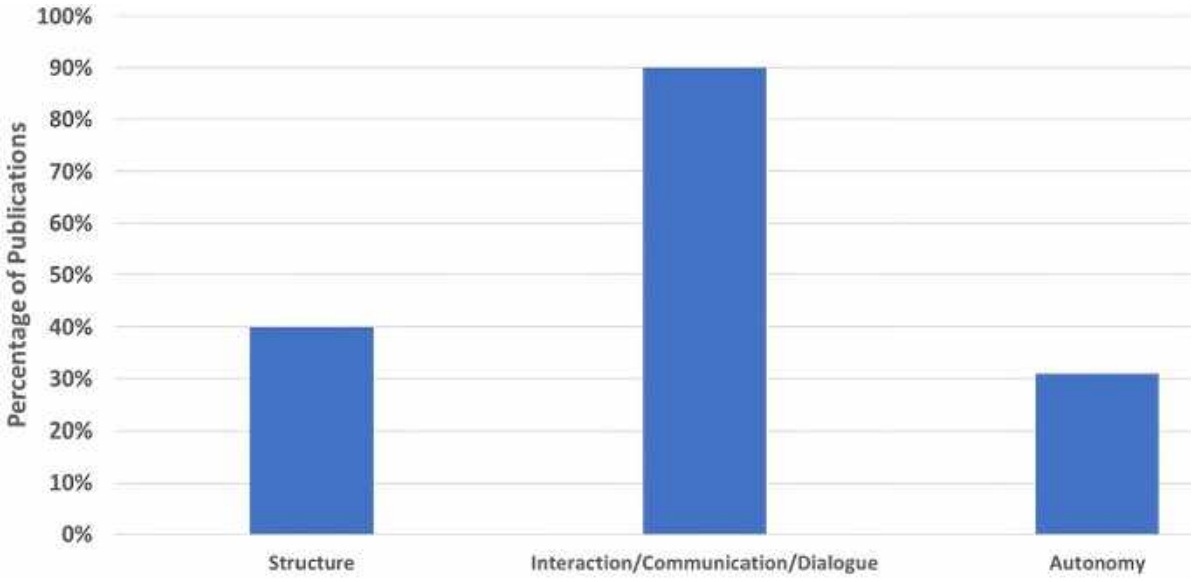

Figure 5. TDT factors & research contributions (Source: Authors)

The documents include studies on the frequency, quality, and types of interactions between learners, instructors, and course materials in online learning environments. Many researchers have explored the effects of different types of communication on student learning outcomes and the factors that contribute to successful interaction and interaction in online courses (Kim et al., 2021). The structure of course materials and their design has also received considerable attention in TDT literature, with around 40.0% of the research focused on this area, but it is insufficient. Studies in this field have mostly looked at the impact of course structure and design on learner engagement, motivation, and satisfaction (Hew et al., 2020). About 31.0% of TDT literature has focused on students' autonomy in online learning environments. The literature about autonomy includes studies on the role of learner autonomy in promoting successful learning outcomes, as well as investigations into the factors that influence learner autonomy in online courses. Additionally, the literature has examined how online courses can be designed to support learner autonomy, such as self-paced learning modules, personalized feedback, and other interactive elements (Achuthan et al., 2021).

Table 2. Top-contributing countries

Name	TP	TC	TC/TP
The United States	106	2,641	24.9
The United Kingdom	27	337	12.5
Turkey	18	267	14.8
South Africa	16	83	5.2
Canada	14	514	36.7
Australia	12	544	45.3
Israel	12	245	20.4
Taiwan	11	508	46.2
Malaysia	8	136	17.0
New Zealand	6	120	20.0

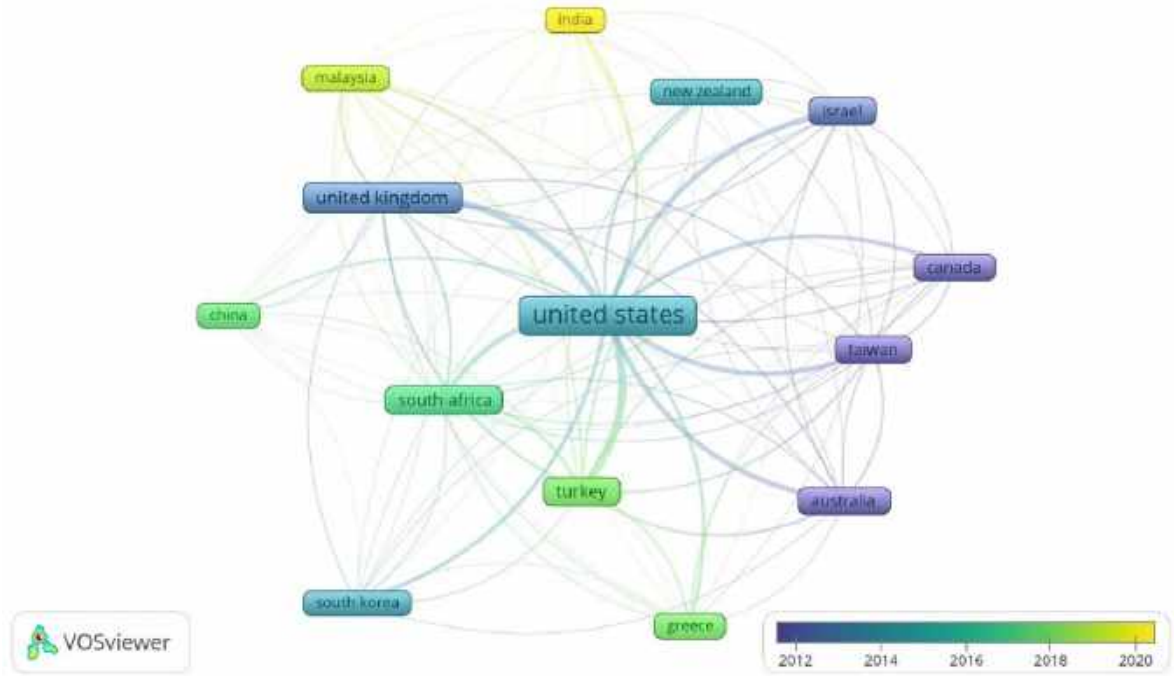

Figure 6. Bibliographic coupling of countries (Source: Authors)

Top-Contributing Countries & Their Bibliographic Couplings

Authors from 53 countries contributed to TDT articles in the review corpus. We identified the most prolific countries based on publications and citations to answer the research question (**Table 2**). Out of 275 publications, 106 (39.0%) were published in the United States (US) and had 2,641 citations. According to the number of documents, the United Kingdom (UK) comes second (10.0%). However, articles (TP=12) from Australia received more citations (total citation [TC]=544) than articles from the UK (TC=337). In order to assess the research contribution of different countries, we calculated the citation mean (TC/TP). This metric provides an understanding of the average number of citations received per publication, indicating how well-received the published works were by experts in the field. The citation means also offers insights into the quality of the publications. TC/TP is higher for Taiwan (TC/TP=46.2) and Australia (TC/TP=45.3). In terms of citations (TC=6,286), 42.0% of the TCs are from the US (TC=2,641), with Australia being the second best (TC=544) at 9.0%. The concentration of articles in the US, UK, and Australia indicates a lack of TDT-based online learning practices in other developing countries worldwide. It foregrounds an alarming lack of evidence-based online learning practices in the demand side of online learning, although the supply side seems grounded in theory. While developing countries might be consuming online learning beneficially, their understanding of TDT-based research on online learning platforms will better inform their choice of supplier or institution. This gap needs to be redressed quickly in a post-pandemic digital world.

The overlay visualization generated via the bibliographic coupling of countries between 1994 and 2022 is shown in **Figure 6**.

Table 3. Top-journals based on TPs (TP=275)

Journals	TP	TC	TC/TP
International Review of Research in Open and Distance Learning	16	1,054	65.9
American Journal of Distance Education	9	216	24.0
Computers and Education	7	769	109.9
Journal of Educational Computing Research	6	98	16.3
Open Learning	6	62	10.3
Distance Education	5	280	56.0
International Journal of Phytoremediation	5	57	11.4
Internet and Higher Education	5	557	111.4
Turkish Online Journal of Distance Education	5	45	9.0
British Journal of Educational Technology	4	183	45.8

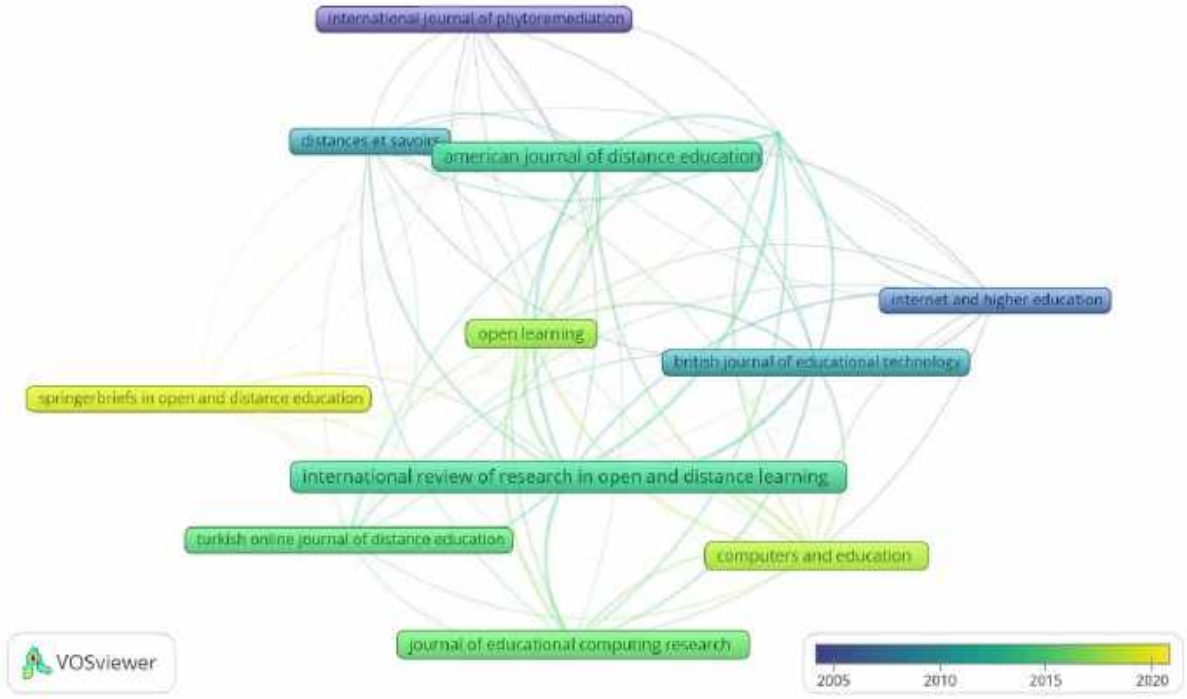

Figure 7. Bibliographic coupling of journals (Source: Authors)

Taiwan, Canada, Australia, and Israel contributed significantly in 2012, while US contributed significantly in 2014. UK mainly contributed in 2013, but in 2018, the main contributor was Turkey. Regarding TDT research collaborations, significant linkages exist between the US, the UK, Canada, Australia, Israel, and Taiwan.

Top-Journals Publishing on TDT & Major Research Themes

Identifying the top publishing journals in a particular field of research is crucial as it provides valuable information for future researchers and scholars. This information can be used as a reference point for targeting the best journals for publishing their research. **Table 3** in the study presents the top journals based on the number of documents related to TDT. *Journal International Review of Research in Open and Distance Learning* holds the top position, with a 5.8% contribution of TPs (TP=16) on TDT. *American Journal of Distance Education*, which focuses on distance learning research, is second, with 3.3% (TP=9) of TPs. The third position is occupied by the journal *Computers & Education*, with seven (2.5%) publications on TDT. Interestingly, the top two journals are dedicated to distance learning research, highlighting TDT's significance in online education.

Regarding the most influential journals, publications in *International Review of Research in Open and Distance Learning* had cumulatively garnered 1,054 (16.8%) citations (TC/TP=65.9). Despite having fewer publications (TP=5), *Internet and Higher Education* account for nearly 8.9% (TC=557) of all citations, with a TC/TP ratio of 111.4. *Computers & Education* (TC/TP=98.14) journal is the second highest citation (TC=769), approximately 15.0% of TCs with TP=7. **Figure 7** displays the visualization of network overlay, representing the bibliographic coupling of the journals.

Table 4. Most influential authors based on TPs & TCs

According to TPs				According to TCs			
Author	TP	TC	TC/TP	Author	TP	TC	TC/TP
Swart, W.	6	83	13.8	Dron, J.	5	130	26.0
Dron, J.	5	130	26.0	Abuhassna, H.	3	101	33.7
Yilmaz, R.	5	57	11.4	Chen, Y.-J.	3	98	32.7
Karaoglan Yilmaz, F. G.	4	55	13.8	Horzum, M. B.	3	87	29.0
Mbatha, B.	4	24	6.0	Swart, W.	6	83	13.8
Wengrowicz, N.	4	28	7.0	Yilmaz, R.	5	57	11.4
Abuhassna, H.	3	101	33.7	Karaoglan Yilmaz, F. G.	4	55	13.8
Chen, Y.-J.	3	98	32.7	Offir, B.	3	48	16.0
Gokool-Ramdoo, S.	3	37	12.3	Macleod, K. R.	3	45	15.0
Horzum, M. B.	3	87	29.0	Paul, R. C.	3	45	15.0
Kara, M.	3	33	11.0	Gokool-Ramdoo, S.	3	37	12.3
Kawachi, P.	3	1	0.3	Zilka, G. C.	3	34	11.3
Kirkup, G.	3	14	4.7	Kara, M.	3	33	11.0
Limtrairut, P.	3	5	1.7	Wengrowicz, N.	4	28	7.0
Macleod, K. R.	3	45	15.0	Mbatha, B.	4	24	6.0

The interconnections among nodes representing various journals reflect the similarity in TDT articles they reference. In contrast, the proximity of the nodes indicates the extent of similarity in the cited publications across these journals. The proximity of the nodes directly correlates with the intensity of the resemblance in the referenced articles within the journals engaged in TDT research. The connections among journal nodes represent the correlation in TDT articles referenced in different journals. In contrast, the proximity of the nodes indicates the degree of commonality in the referenced publications across journals. The majority of the documents were published in the *International Review of Research in Open and Distance Learning* during 2012-2013 and in *Computers & Education* post-2017. *Internet and Higher Education* published articles before 2010. A strong link between *International Review of Research in Open and Distance Learning* and *Distance Education*, *British Journal of Educational Technology*, *Open Learning*, *Journal of Educational and computing research*, and *Computers & Education* can be seen.

Most influential Authors

Based on the publications from 1994 to 2022, **Table 4** provides an overview of the most influential authors in the diverse interdisciplinary areas of TD. W. Swart emerges as the top author with the highest number of publications (TP=6), followed by J. Dron (TP=5), and R. Yilmaz (TP=5). It is worth noting that TC/TP values of W. Swart and R. Yilmaz are comparatively lower than those of other authors. But when evaluating performance from a quality perspective, considering TC/TP ratio, J. Dron, with five publications, has a TC/TP value of 26.0, suggesting a relatively higher impact or citation rate per publication. Similar to the case of Y.-J. Chen, who has three publications and a TC/TP value of 32.7. The most cited (TC=468) publication is Y. Park's "*A pedagogical framework for mobile learning: Categorizing educational applications of mobile technologies into four types*." This paper discusses the use of mobile technologies in distance learning and their potential as a learning tool for students. In the paper, the authors also discuss the technological characteristics and educational benefits of m-learning and contrast it with electronic learning (e-learning) and ubiquitous learning (u-learning), and mobile learning (m-learning). The author also modifies TDT and uses it as a theoretical foundation for m-learning. According to TD theory, the author classifies earlier research into four categories of m-learning: high and low TD socialized m-learning and high and low TD individualized m-learning. The paper aims to provide instructional designers of open and distance learning with a better understanding of m-learning and how it can be effectively incorporated into their teaching and learning. The most cited publication of J. Dron is "*Designing the undesignable: Social software and control*," which was published in *Educational Technology and Society* in 2007. The articles received 87 citations, and the paper discusses use of social software in e-learning and proposes a model that incorporates group dynamics within the system. The paper suggests that social software, such as blogs, wikis, tagging systems, and collaborative filters, can enhance traditional e-learning methods by including the group's emergent properties. This approach particularly benefits lifelong learners and those not in formal educational institutions. It also highlights potential dangers and challenges associated with this model and suggests a framework of principles for designing educationally oriented social software.

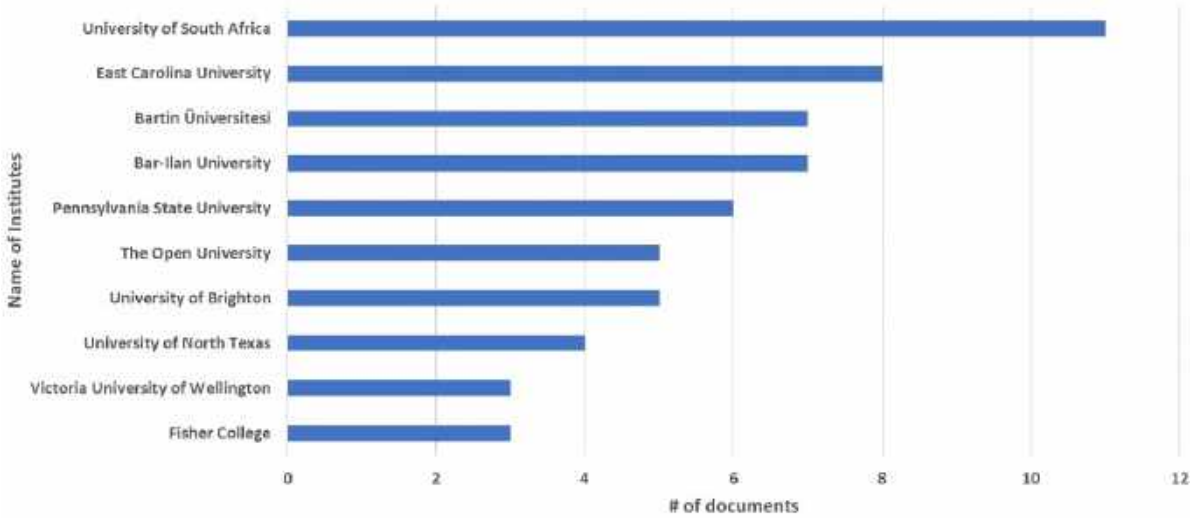

Figure 8. Top-10 institutions based on number of publications (Source: Authors)

Table 5. Type of review articles

No.	Type of review	TC	Reference
1	Scoping review	29	Rhim and Han (2020)
2	Comprehensive review	9	Kruft and Kock (2019)
3	Scoping review	70	Blayone et al. (2017)
4	Scoping review	10	Wold (2011)

One of the notable observations is the presence of authors like H. Abuhassna and Y.-J. Chen., who have a relatively low number of publications (n=3) but have garnered a substantial number of citations (101 and 98, respectively). This indicates that their work has significantly impacted and resonated with other researchers, leading to a high average number of citations per publication (33.7 and 32.7, respectively). On the other hand, authors like B. Mbatha and N. Wengrowicz have a higher number of publications (n=4) but receive fewer citations (24 and 28, respectively).

Most Influential Institutions

Analyzing the number of publications related to TD theory, it becomes evident that several institutions have made significant contributions. **Figure 8** shows the documents based on the affiliation. University of South Africa has emerged as a prominent institution, having published eleven papers. The substantial research output from University of South Africa strongly emphasizes advancing the understanding of TDT and its implications for online learning. Following closely behind, Bar-Ilan University and Bartin University have made significant contributions with seven publications each. Notably, University of Brighton and Open University have also demonstrated a substantial interest in TDT, each publishing five papers.

The typology of reviews on TDT, its application, and pedagogical constructs is presented in **Table 5**. Our findings indicate that the majority of studies conducted in this field have relied heavily on informal reviews, such as literature surveys and reviews that do not provide detailed explanations of the study's methodology. An early review conducted in 2017 already propositioned a fully online educational system as a sustainable prospect by conceptually reviewing fully online learning community (FOLC). According to Blayone et al. (2017), FOLC is presented as a solution to a number of issues, including the need for increased educational emphasis on the development of higher-order competencies, the shortcomings of distance learning and MOOCs as learning models, and the search for new learning models that improve deliberation skills. It serves as an example of democratized learning communities that encourage negotiated technological affordances and cognitive outcomes, minimize TD between learners and instructors, include real evaluation, and share responsibility for constructive criticism. A post-COVID-19 overview of online learning in medical schools was included in the latest review in the field (Rhim & Han, 2020). In the context of medical education, the study offered foundational concepts of online learning (such as TD, presence, and independent learners) as well as practical guidelines.

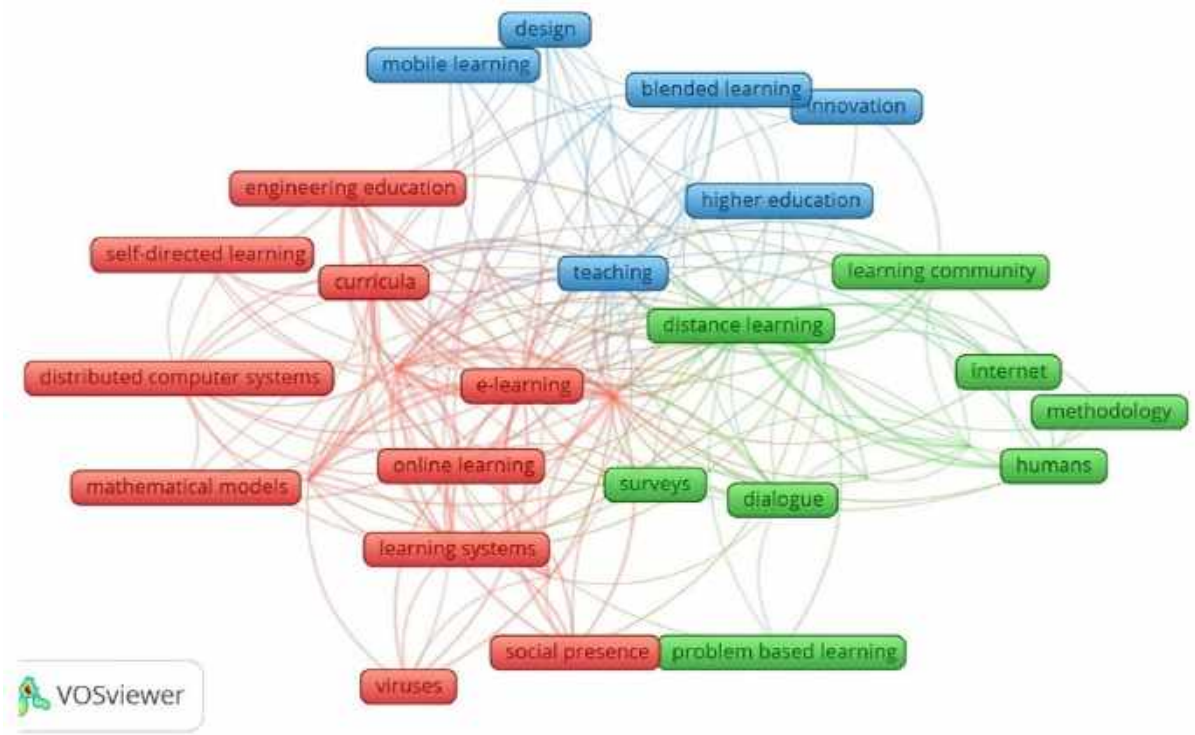

Figure 9. Thematic mapping of keywords (TP=275) (Source: Authors)

The review distinguished itself by characterizing learners as active, capable, and independent individuals instead of passive recipients of information. Additionally, this review outlined five online pedagogical guidelines: provide practice opportunities, design/facilitate interactions, support both synchronous and asynchronous learning, and foster a learning community. Design structures and flows to embrace experiential learning (Rhim & Han, 2020). Kruft and Kock (2019) discussed TDT in corporate incubation. The study looked at how incubators can be broadly classified and how various goals and tactics relate to corporate incubator performance. Using a sample of incubators from 14 industries, cluster and regression analysis results show 16 clusters based on five strategy criteria and objectives. TDT helps explain the various relationships between the criteria and performance. There is a clear absence of methodological reviews focused on aggregation and synthesis, such as meta-analysis and scoping reviews. In particular, we observed a complete absence of meta-analysis studies and systematic reviews. A clear observation is the absence of methodological reviews with aggregation and synthetic objectives, such as meta-analyses and scoping reviews. Particularly, we discovered a complete absence of meta-analysis studies and systematic reviews. This scarcity of research in the early stages of the pandemic may have contributed to the lack of such studies. Nevertheless, as the abundance of research materials continues to grow, a promising prospect emerges to employ meta-analyses, leading to an expectation of an upsurge in similar types of evaluations. Such investigations signify the evolution of the research domain, facilitating researchers in formulating valuable deductions and discerning prospective avenues for further study.

Thematic Mapping of Keywords

The thematic analysis of keywords suggests three main categories

(1) distance learning,

(2) online learning, and

(3) blended learning) (**Figure 9**).

To better understand the thematic relationships, we refer to all the non-digital remote learning as distance learning and all the remote learning that utilizes internet and any kind of digital technologies to deliver educational content and offer interactions between instructors and students as online learning. To understand the research questions studied in each category, the present study considered the systematic

review of top cited TDT articles. Across the sampled articles, the research questions primarily comprised three angles. Firstly, the introduction of learning tools or platforms and their impact on reducing the TD for optimal learning outcomes. Secondly, the relationship between learning factors and the impact of newly introduced factors on learning outcomes. The studies explore design factors such as interaction and course structure and humanistic factors such as social presence and academic emotions about learning. These research question types demonstrate the depth of consideration researchers display in trying to improve the quality of courses and highlight the need for ongoing research and innovation to improve aspects of education continually. However, a broader view should be considered to include other types of investigative research questions.

Distance Learning (Non-Digital)

Distance learning is an educational approach in which students and instructors are physically separated, and communication and learning occur through various forms of technology (Sevnarayan, 2022). While online learning is a subset of distance learning, distance learning can also include other methods, such as correspondence courses (via mail) or satellite broadcasts (Pregowska et al., 2021; Shahabadi & Uplane, 2015). The primary goal of distance learning is to provide educational opportunities to students who cannot attend traditional, in-person classes due to geography, time, or other constraints. Distance learning challenges include isolation, limited interaction with instructors and peers, and technological barriers (Simonson et al., 2011).

The study delved into understanding the structure dimension in distance learning, focusing on flexibility and rigidity, curriculum, instructions, technology, and evaluation. While some research suggests that curriculum design is vital in distance education, others point out that more attention is given to other elements like evaluation. The paper recommends for education providers to design distance learning environments with a keen focus on structural components, adopting suitable technologies, and maximizing flexibility. Policymakers should also factor in these elements when framing guidelines for distance education. Chawinga et al. highlighted several challenges with distance learning such as delays in feedback from lecturers, late release of semester results, and insufficient study materials (Chawinga & Zozie, 2016). The study recommends timely result releases, motivating lecturers through incentives, establishing satellite learning centers and improving communication. Kang et al. compared TD theory with cultural history activity theory, where the latter emphasized tool-mediated or sign-mediated interactions (Kang & Gyorke, 2008). The study examined the core concepts of TD theory, highlighting the contradictions and complementary nature of structure, dialogue, and autonomy in TD. There's empirical support for Moore's (1972) TDT, which posits that distance learning environments increase communicative. Offir et al. (2004) study findings provide insights into compensatory strategies that can be used to reduce TD inherent in DL settings. By understanding how distance learning dynamics affect interactions, educators can make informed decisions regarding learning objectives and environments. Moreover, data-driven insights can help teachers fine-tune their strategies to reduce TD in distance learning.

Online Learning

Regarding the subject matter, a deeper understanding of TDT's application in solutions is visible in the literature due to distinguishing between the key features of online learning as opposed to distance learning. Online learning is a form of education that utilizes the internet and digital technologies to deliver course content, instruction, and interaction between learners and educators. Students access educational materials, complete assignments, participate in discussions, and receive feedback through web-based platforms. Online learning, however, is a subset of distance learning designed to give students access to educational materials, complete assignments, participate in discussions, and receive feedback through web-based platforms.

Online learning can be synchronous, where students and instructors interact in real-time (e.g., live video conferences), or asynchronous, where students work at their own pace and communicate with instructors and peers as needed (e.g., discussion boards or email) (Shahabadi & Uplane, 2015). Student engagement and interaction with instructors and peers are distinguishing factors for success in online learning environments (Dixson, 2010; Richardson et al., 2017). While time management challenges are unique to online learning (Muilenburg & Berge, 2005) and challenges related to having limited peer-instructor interaction are unique to

distance learning, common challenges have been addressed in the literature. Some overlapping challenges are feelings of isolation and technological barriers (Fattore, 2022; Swart & Macleod, 2021). While technological issues have been reduced by research focus on platform design, accessibility to online learning still needs to improve. Especially in developing countries, the digital divide contributed by many factors, such as socioeconomic status, must be bridged. Another gap in the literature lies in limiting research focus to designing platforms and characterizing the impact of TDT-mediated strategies on learner outcomes alone (Simonson et al., 2011). Insufficient research focuses on learner isolation or other academic emotions. The studies draw on online learning, mainly examines the distance between learners and instructors in online learning environments and how this affects learning. Outcomes (Bolliger & Halupa, 2018; Ekwunife-Orakwue & Teng, 2014; Yilmaz & Keser, 2017). The studies also explore factors such as interaction, course structure, social presence, and academic emotions about online learning (Yu et al., 2020). Overall, these research questions demonstrate the importance of considering a range of factors in the design and delivery of online courses and highlight the need for ongoing research and innovation in this field to continually improve the quality and accessibility of online learning.

Blended Learning

Blended learning, also known as hybrid learning, combines traditional face-to-face instruction and online learning elements (Zilka et al., 2019). In this approach, students attend in-person classes for certain activities, such as lectures, workshops, or labs, and participate in online learning for other aspects of the course, such as accessing materials, completing assignments, or engaging in discussions. Blended learning aims to take advantage of the benefits of both in-person and online learning experiences to create a more flexible, engaging, and efficient learning environments (Liotsios & Demetriadis, 2010). Challenges of blended learning include ensuring a balance between online and in-person components, managing workload, and addressing the diverse needs of learners (Vaughan, 2007).

The studies cover a wide range of topics, including the effect of TD dialogic interactions on academic achievements of students (Ekwunife-Orakwue & Teng, 2014), the use of mobile devices to enhance TD and student engagement (Elyakim et al., 2019), the role of teacher and social presence in virtual and blended courses (Zilka et al., 2018), and the design factors that enhance learning in hybrid courses (Shea et al., 2016). The research questions offer insights into various aspects of blended learning, such as the importance of effective student interactions with instructors, technology, content, and peers in blended environments. Additionally, the studies investigate the importance of teachers and social presence on students' perceptions of risk, difficulty, motivation, and self-efficacy in online and blended courses. The findings have implications for educational policies, teaching practices, and technological tools to support and enhance blended learning environments.

Our literature analysis also identified three broad categories addressed by research questions: students, instructors, and infrastructure. Research questions within the student's category can be classified into two main groups:

(1) those addressing blended learning challenges and

(2) those addressing distance learning challenges.

Major issues in blended learning include accessibility to learning management systems (LMS) and LMS design (Chen et al., 2009; Kawachi, 2008; Tirronen et al., 2020; Ustati & Hassan, 2013), while distance learning research primarily focuses on student motivation, accessibility, societal factors, the impact of the COVID-19 pandemic, and student autonomy (Amoozegar et al., 2022; Brown, 2022; Zilka et al., 2019). As for the instructor category, research questions can be divided into three primary groups:

(1) those addressing distance learning issues (Kanuka et al., 2002),

(2) those addressing blended learning issues (Wengrowicz, 2014; Wengrowicz & Offir, 2013), and

(3) those addressing the need for support staff (Delaney & Betts, 2022; S. Park & Robinson, 2022).

The main concerns in asynchronous distance learning include instructors' technological abilities and infrastructure capabilities, while common problems in synchronous learning relate to video conferencing. Like the student category, LMS accessibility and design are the primary topics a blended learning research

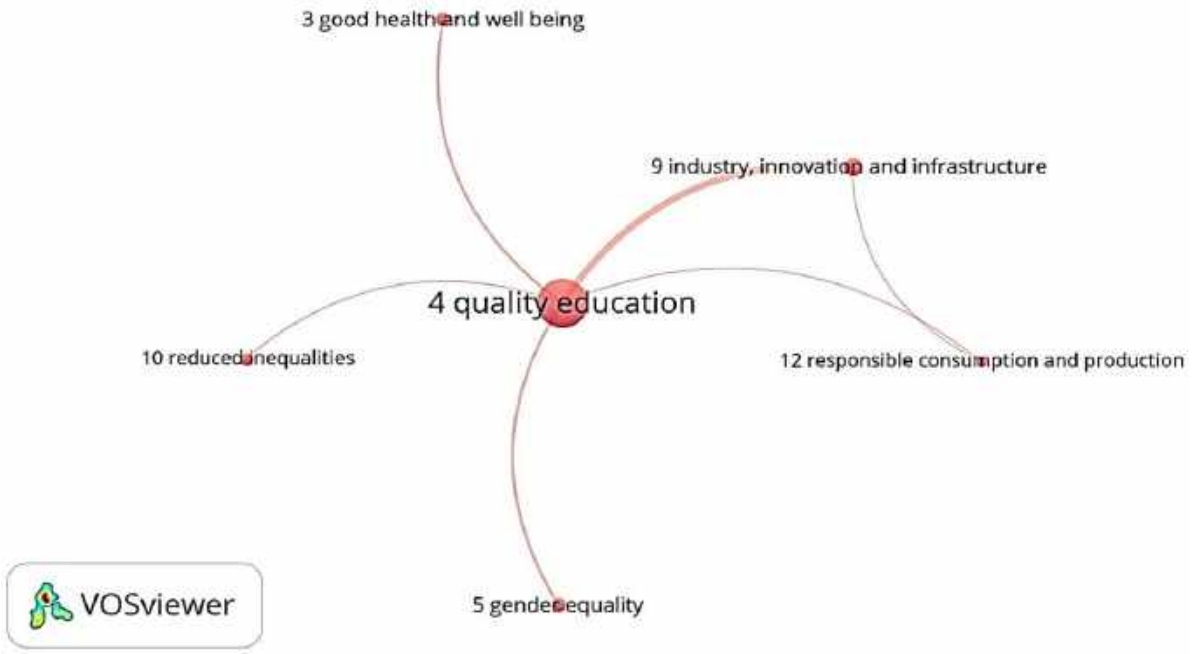

Figure 10. Transactional distance theory & sustainable development goals (Source: Authors)

address. Regarding infrastructure, research questions can be grouped into two categories based on learning methods (asynchronous and synchronous) (Alhazbi & Hasan, 2021; Shahabadi & Uplane, 2015). In asynchronous learning, the common themes are accessibility, design, and availability of LMS systems, while in synchronous learning, the primary focus is on interaction in video conference methods.

Mapping TDT Research to Sustainable Development Goals

Recently several studies have examined how well a research topic maps to SDGs–management research (Pizzi et al., 2020), women entrepreneurship (Raman et al., 2022c), green-hydrogen (Raman et al., 2022b), cyberbullying (Achuthan et al., 2023). The interdependence of SDG goals has been established, indicating that the accomplishment of one goal is reliant on the success of other goals (Nilsson et al., 2016). Moreover, network analysis techniques have revealed that the connections between SDGs are somewhat unequal (Le Blanc, 2015), with some goals having multiple targets that connect them to many other goals while others have weak connections to the rest of the SDG system. We visualized the relationships between different SDGs using a co-citation map in our study. The map shows a single cluster, with the proximity of the SDGs indicating their similarity in terms of co-citation occurrence and the nodes' size representing the frequency of SDG throughout all publications (**Figure 10**). With SDG 4 (quality education) having the highest frequency, the strongest links are observed between education and innovation (SDG 4 and SDG 9), followed by education and gender equality (SDG 4 and SDG 5).

The highly cited paper by Park (2011) provides a comparative analysis of mobile, electronic, and ubiquitous learning and explores their technological characteristics and educational advantages. The paper highlighting their potential relevance to SDG 4, which focuses on ensuring quality education (**Table 6**). By categorizing existing research into four types of mobile learning, instructional designers may use it to efficiently integrate mobile technology into their educational programs. The study by Chen et al. (2014) develops a research and design model for flipped learning in higher education, which aligns with SDG 4 targets of increasing access to quality education and improving learning outcomes. The flipped learning model in higher education has gained many followers and converts but remains underutilized and underexplored. The model was implemented and evaluated, showing effectiveness in increasing attendance and study efforts and changing TD during the learning process. Another highly cited study by McBrien et al. (2009) examines virtual classroom space in undergraduate and graduate courses, employing TDT as a framework with implications for lifelong learning opportunities under SDG 4. The study identifies themes related to dialogue, structure, learner autonomy, and issues related to convenience, technical challenges, and pedagogical preferences.

Table 6. List of highly cited articles mapped to SDGs

TC	Title of the article	Authors	Key focus
468	*A pedagogical framework for mobile learning: Categorizing educational applications of mobile technologies into four types*	Park (2011)	Mobile learning
362	*Is FLIP enough? or should we use the FLIPPED model instead?*	Chen et al. (2014)	Flipped classrooms
266	*Virtual spaces: Employing a synchronous online classroom to facilitate student engagement in online learning*	McBrien et al. (2009)	Virtual classrooms

Theoretical & Practical Implications of Transactional Distance Theory

In the evolving landscape of education, distance learning, online learning, and blended learning have emerged as key themes. Despite its advantages, distance learning brings about challenges such as student isolation, limited interaction, and technological hurdles. With online learning, engagement becomes pivotal; it's distinguished by the interaction levels between peers and instructors, and the success therein is often influenced by individual time management capabilities. Blended learning, while benefiting from both realms, faces the challenge of balancing its components effectively. TDT has been a prominent framework in online and distance learning, focusing on the psychological and communication gaps between learners and instructors along with distances between learners, learners, and content, as well as learners and technology (**Figure 9**). Understanding and reducing TD is crucial for creating effective learning environments that promote student engagement, satisfaction, and learning outcomes. This section explores various studies that have investigated the application of TDT in different contexts, such as blended learning, e-learning, cross-cultural settings, and mobile learning. It also examines factors contributing to reducing TD, including learner characteristics, cultural sensitivity, feedback modalities, learner autonomy, and teacher presence.

Course and platform design are core aspects of online learning. As part of the design process especially with blended learning (Benson & Samarawickrema, 2009), incorporating high affordances for structure can ensure low TDs through the planning of learning tasks and timeframes integrated within scaffolding strategies. Perception plays a crucial role in shaping individuals' experiences and behaviors. In online learning, learners' perceptions of various factors (Bolliger & Halupa, 2018), such as communication, engagement, interaction, and outcomes, can significantly impact their overall learning experience and academic achievement.

The unique characteristics of learners, such as their needs, preferences, and prior background, play a significant role in TD. Ekwunife-Orakwue and Teng (2014) found that increased engagement in dialogic interactions in the blended learning context leads to better student performance. Combining online and direct classroom interaction can reduce the perceived TD and improve learning outcomes in blended learning scenarios compared to fully online learning. Li et al. (2022) demonstrated that allowing students to control the learning sequence can enhance academic performance, increasing learner agency and autonomy. Abuhassna et al. (2022) highlighted the importance of learner autonomy in online scenarios, emphasizing that students' prior experience with technology influences their perception and expectations of course design and structure. Learner autonomy enables students to take ownership of their learning process, leading to better learner development and outcomes. Valencia-Arias et al. (2019) identified self-efficacy and learner autonomy as crucial factors for online adoption, as they contribute to enhanced flexibility and learner experience. Mechanisms to enhance motivation and engagement through better dialogue, structure, and autonomy can provide the flexibility and independence necessary to achieve learner success (Cebi, 2023; Vonderwell, 2003).

Cultural sensitivity and understanding are essential for reducing TD and promoting effective communication and collaboration among culturally diverse learners. The study by Titarenko and Little (2017) emphasized the importance of cultural sensitivity in online learning environments. They explored tools and strategies that enhance communication, collaboration, and engagement among culturally diverse learners. Their findings are equally relevant in the distance learning context as well. Facilitating learner-centered approaches (McBrien et al., 2009; Swart & Macleod, 2021) such as democratic dialogues, student-led discussions, and web-based assignments, encourage open and expressive participation, reducing TD between students and content and student interactions.

Feedback is crucial in reducing TD and enhancing the learning experience. Studies have shown that the feedback modality affects learners' perception and engagement. Mathieson (2012) and Melezhik et al. (2020)

found that video feedback is more effective than text or image-based feedback. Combining multiple modalities like video, text, and images can create a more personal and engaging feedback experience in online or blending learning contexts. Written feedback would be the only option to receive feedback with non-digital distance learning. Kandemir and Cakmak (2021) highlighted the importance of designing evaluation strategies that incorporate formative methods and provide multiple types of evaluations. Such strategies promote learner autonomy and reduce TD by providing various opportunities to demonstrate understanding and progress.

Mobile learning has gained significant attention in recent years, and its application aligns with reducing TD, which could be incorporated for digital online learning. Park (2011) presented a framework for mobile learning that divides educational activities into four categories: content delivery, social interaction, assessment and feedback, and authentic learning. This framework reduces spatial and temporal constraints, enhances social interaction with the community, provides immediate feedback, and bridges the gap between thinking and action. Mobile learning offers flexibility and accessibility, which can minimize TD by enabling learners to engage in learning anytime and anywhere. Another study by Elyakim et al. (2019) focused on the impact of technological and pedagogical elements in mobile learning on learning outcomes. Through engineering-mediated learning experiences through mobile learning, the researchers demonstrated significant improvements in student learning outcomes. This suggests that leveraging technology and incorporating effective pedagogical approaches in mobile learning can enhance the learning experience and improve academic achievement.

Learner satisfaction and persistence are crucial for the success of online learning. Studies have shown TD affects learner satisfaction, engagement, and outcomes. The study by Weidlich and Bastiaens (2018) found that learner satisfaction decreased as TD increased. They suggested that technological factors such as social presence, immediacy, and responsiveness mediated this relationship, mitigating the negative impact of TD on learner satisfaction. Students with positive online learning experiences are more likely to persist and achieve their academic success. Understanding the factors contributing to reducing TD can increase learner satisfaction, persistence, and academic success. Alhazbi and Hasan (2021) conducted a comparative analysis between synchronous and asynchronous learning contexts and found that self-regulation directly and indirectly influences synchronous and asynchronous online learning contexts. Learners who engage in self-regulated learning behaviors, such as setting goals, managing their time effectively, and monitoring their progress, are more likely to achieve positive learning outcomes.

Teachers play an extremely dominant role in affecting TDs by affecting student motivation, participation, engagement, satisfaction, and ultimately student success. Teacher presence is critical in reducing TD and enhancing student engagement and satisfaction. Hew et al. (2020) examined the impact of TDT elements on student satisfaction with MOOCs. They found that positive student-teacher communication, clear instructions, structured lesson plans, and student autonomy significantly predicted higher satisfaction levels with MOOCs. This also translates to the importance of teacher guidance, course design, and responsive teaching in minimizing TD. Teachers who actively participate, provide clear instructions, offer feedback, and foster collaborative activities can create low TD structures. They can also promote learner autonomy and social presence by fostering positive social interactions and collaborative learning experiences. Kebritchi et al. (2017) emphasized the role of social presence in reducing TD, suggesting that instructors should strive to create a supportive and interactive learning community. Kara and Yildirim (2020) detail various optimal traits of teachers in creating low TDs in structures, dialogues, and autonomy. From course design to encouraging students towards collaboration, guiding the learning process with tools and pedagogy, to effective evaluation and positive social interactions. Dockter (2016) summarizes the teacher presence and their contributions as being managerial, social, and pedagogical. While all behaviors are impossible for all teachers, they can serve as guidelines for improvisation.

Understanding these factors and their implications can help educators design effective learning experiences that minimize TD, enhance student engagement and satisfaction, and promote meaningful interactions between learners and instructors. Abuhassna et al. (2020) developed a platform utilization model to guide the implementation of online platforms in educational settings. The findings revealed that students perceived online learning platforms as valuable tools for academic achievement. Factors such as the quality of content, ease of navigation, interactivity features, and technical support significantly influenced student

satisfaction with online platforms. A well-structured course with scaffolded strategies can diminish TD, which is the perceived gap between learners and their educational experience. Future research should continue to explore these factors and their implications for designing optimal online and distance learning environments. By reducing TD, educators can create inclusive and engaging learning environments that meet the diverse needs of learners.

Summarizing, in the context of distance learning, perception often revolves around the legitimacy and efficacy of educational methods, especially when compared to traditional learning environments. There may be apprehensions concerning the quality of education and the potential for genuine engagement. Timely and effective feedback can be challenging and persistence in distance learning often relies on a student's intrinsic motivation. For online learning, interactivity, multimedia usage, and adaptive learning paths can enhance online courses. Online forums, group projects, and live video sessions can help mitigate feelings of isolation and impact TD. Peer-to-peer interaction can be encouraged via discussion boards, group assignments, and collaborative tools within the online forums can enhance the autonomy of learners. Regarding blended learning, the perception of balanced approach that includes combining traditional with online best practices, mix of in-person and online automated feedback offers comprehensive insight of learners. The course design can be a challenge with respect to structuring the in-person and online sessions. However, regular, and multifaceted interactions between the student and teachers can boost persistence and learning outcomes.

FUTURE DIRECTIONS

From time immemorial, evolution has happened consequential to learning and gathering new knowledge and thus can be considered synchronous. With the advent of the internet and the provision of its public access, the world wide web served as a global catalog to search and locate information. The development of course offerings transformed the internet from being a mere information search engine to a platform enabling formal education (Ananga, 2020). Distance learning, which is non-digital has credibility issues and the perception of degrees earned through distance mode is diminishing. Ther emergence of MOOCs since the start of the new millennium has witnessed an incredible growth while providing self-paced educational opportunities. The recent COVID-19 was a testament to the critical importance online learning offers towards sustainable development. Online courses were developed based on the best practices in classrooms and further optimized based on some seminal studies (Falloon, 2011) of online students. While these served as the gold standard for over a decade, their ability to cater to the exponential volume and diversity of students and their varied learning styles has been limited. The prominent terms identified during this bibliometric study can also be explored further because they represent active research topics in the online learning field.

Engaging MOOC Design

In the field of online and blended learning, the "experience of learning" and "learner satisfaction" are paramount. As MOOCs evolve, they reflect the broader shifts in these thematic areas, making the experience immersive and personalized irrespective of the abstractness of the concepts being taught. Game-based learning approaches, a hallmark of innovative online platforms, emphasize proactive engagement and constructive feedback (Ray & Bennett, 2023). Such strategies not only make the learning experience adaptive but also resonate with the blended learning model, where digital game elements can be combined with traditional classroom approaches to engage learners more deeply. The future designs of MOOCs, both for purely online courses and their blended counterparts, should highlight the metacognitive quality of the course. It's crucial to have transparency that showcases flexible pedagogical strategies, enhancing learner autonomy–a principle underscored by Hew et al. (2020). As we pivot towards a future, where online and blended learning environments reconsider traditional learning processes, there's a marked shift from the linearity of learning content. Presenting content as part of a networked, interconnected system is emerging as a trend (Ariel et al., 2023), a nod to the modular and flexible structures inherent to online and blended modalities. Lastly, platforms that interlink problem-based learning and gamification, a feature most prevalent in online scenarios, are gaining traction (Behl et al., 2022). These platforms, especially in a blended learning context, hold immense potential for retaining young learners, allowing them to seamlessly transition between online and offline learning environments, thereby maximizing engagement and retention.

Online Assessments

Innovative approaches to assessment and credentialing are emerging paradigms that provide opportunities to amplify the impact of teaching and education. These approaches, especially when applied in the online and blended learning contexts, provide profound opportunities to amplify the impact of teaching and education. However, there remains a considerable gap in studies correlating the impact of course level and learner-level features comprehensively on online and blended learners. Hew et al. (2020) delved deep into the world of MOOCs, characteristic of the online learning ecosystem, and identified that course assessments, instructors, and content played a pivotal role in influencing student satisfaction. In tandem with this, a blended learning perspective introduced by Rolfe (2015) emphasizes a paradigm shift. Moving away from traditional online examinations, it's imperative to focus on learners demonstrating skills and abilities. This approach, inherent to blended learning, allows for a more holistic representation of performance and learning, bridging the online-offline divide. Feedback and participation mechanisms have witnessed a significant transformation, especially in online and blended learning models. While interactive sessions like question-and-answer interactions between teachers and students are a testament to engagement, use of technology could enhance these as well. A deeper understanding is exhibited when students, whether in an online module or a physical classroom, actively use collaborative tools such as blogs or chats to express their perspectives or approaches. This convergence of modalities allows for a richer, multi-faceted learning experience. In the domain of credentialing, micro, meso, or macro credentials offer an innovative approach, especially apt for online and blended learning environments. They enhance learner flexibility and challenge the norms of traditional assessments. While enforcing online proctoring for assessments, common in pure online contexts, is a widely accepted practice, there's a need for caution. As observed by Lee and Fanguy (2022), it might cast negative impressions on students, a sentiment echoed across both online and blended learners.

Social Presence in Online Learning

Social interactions are foundational to learning experiences. Social presence, defined as the awareness and acknowledgment of both the teacher's presence and the community of learners coupled with active communication between them (Rovai, 2000), plays a pivotal role in both online and blended classrooms. While traditional online learning is often tied to asynchronous tools and pedagogies, blended learning models incorporate both asynchronous and face-to-face components, which might help bridge the gap. Synchronous interventions in both models, such as establishing a social presence, have been shown to lower TDs (Kim et al., 2021). Luo and Chea (2020) highlight the significance of embedding both social and technical facets of social presence in the learning process design. By doing so, not only does it foster collaboration and communication, but it also enhances the outcomes of online and blended learning experiences. Drawing from the insights of Bolinger and Halupa (2018), the intricate relationship between student engagement, TD, and student progression or outcomes becomes evident. Within both online and blended learning contexts, student engagement is found to be directly proportional to the reduction in TDs, whether it's between students and teachers or students and content. This interrelation has profound implications, especially in blended learning, where the blend of online and offline modalities can be optimized to facilitate guided learning and foster richer student interactions. Recognizing the prominence of these paradigms, there's still a limited understanding of the potential that emerging technologies can offer in enriching online and blended learning experiences. Therefore, it becomes imperative to spearhead studies that explore these connections, especially within varying sociocultural contexts.

We recommend institutions delivering education through distance learning, online or blended modes develop guidelines and framework that emphasizes a learner-centric approach, incorporating elements of game-based learning, metacognition, transparency, and flexibility while addressing the unique needs of MOOC learners. Regular assessment, adaptation, and improvement are key to creating an interactive MOOC that maximizes learner satisfaction and engagement. Additionally, ongoing research and adaptation are crucial for educators to stay current with emerging trends in assessment and credentialing. Promoting innovative and effective assessment practices in online learning is key while emphasizing the importance of diverse assessment methods, feedback, student engagement, and flexibility in credentialing to enhance the overall educational experience. Integrating synchronous elements into online courses such as live chats and

video conferencing to facilitate real-time interactions between students, teachers, and peers foster social presence. The direct correlation between student interaction and lower TDs should aid in prioritizing training and professional development for instructors so as to equip them with pedagogical strategies and tools to enhance the sense of community. Literature is sparse on both technological needs and impact of current online, blended or distance learning practices on students with disabilities and hence is important to pursue to allow inclusivity.

CONCLUSIONS

The application of TDT has experienced significant growth in recent years, particularly from 2020 to 2022 within the academic research community, due to the rise of online learning and e-learning during the pandemic. TDT research is predominantly conducted in the social sciences, accounting for 83.7% of studies, while computer science represents 42.6%. Nursing, neuroscience, and health professions contribute less to TDT literature. Interaction or communication garners the most attention among the various aspects of TDT, with roughly 90.0% of research focused on this area. The design and structure of course materials also receive substantial consideration, with approximately 40.0% of research dedicated to this topic. The US leads regarding TDT research publications and citations, followed by the UK, Turkey, and Canada. Notable journals in TDT include *International Review of Research in Open and Distance Learning*, *American Journal of Distance Education*, and *Computers & Education*.

Researchers have expanded the scope of TDT by introducing new dimensions and scales, such as relative proximity theory and Coll-TD scale, resulting in a more comprehensive understanding of TD phenomenon. Several influential authors have made significant contributions to TDT literature, including W. Swart, J. Dron, and R. Yilmaz. Additionally, Y. Park's publication on a pedagogical framework for mobile learning holds the highest citation count in the field. Based on affiliation, University of South Africa and East Carolina University have published the highest number of articles on TDT.

The analysis of research questions across the literature showed that questions could be grouped into two main areas, i.e., blended and distance learning. The main concerns in blended learning revolve around the accessibility and design of LMS. On the other hand, distance learning research primarily centers on student motivation, accessibility, societal factors, the influence of the COVID-19 pandemic, and student autonomy. Our review also details various theoretical and practical aspects of research that help understand the intricacies of building a successful MOOC or online course.

Three main emerging topics emerged, including engaging MOOC design, innovative ways to address online assessment by giving more autonomy to the learners, and social presence in online learning. Ultimately educators should be aware of the concept of TD and work to reduce it. Develop strategies to make the learning experience more personal and interactive, minimizing the psychological and communication gaps is critical for the three modalities studies in this paper, i.e., distance learning, blended learning and online learning. More longitudinal studies are required to examine the long-term effects of social interactions on student progression and outcomes for online and blended learning.

In terms of the SDGs, TDT research is closely aligned with SDG 4 (quality education) and has strong connections to SDG 9 (innovation) and SDG 5 (gender equality).

There are some limitations to the study as well. This review focused on TDT research conducted within specific disciplines rather than interdisciplinary or multidisciplinary research. Future research should address these limitations and continue to explore the implications of TDT for online, distance, and blended learning, as well as its connections to other SDGs.

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