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Promoting sustainable terminology use: A critical discourse analysis of Turkish dissertations in educational technology

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ABSTRACT: This descriptive-interpretive qualitative study analyzed educational technology scholars' written discourse with the goal of promoting sustainable terminology usage in the educational technology field. The study analyzed 105 conceptual definitions extracted from 191 doctoral dissertations on various forms of technology-based learning, including online learning, distance learning, e-learning, Web-based learning, virtual learning, computer-supported learning, open learning, computer-aided learning, and computer-assisted learning. Through critical discourse analysis, the study developed a framework called "Technology-based Learning Environments" (TLE) which focuses on understanding the nature of technology-based learning contexts by examining key aspects such as space, time, agents, levels of operation, rules, power, and culture. The study suggests that the TLE framework can be useful for improving both the design of learning environments and research into the effectiveness of technology-based learning settings from a sustainability perspective.

Keywords: Technology-based learning, Sustainability, Distance education, Online learning, Definition analysis

1. Introduction

1.1. Sustainable terminology use in educational technology

The principle "form follows function (FFF)" is a well-known guideline in architecture and design (Reid, 2007). This approach emphasizes that a design's main objective is to efficiently and effectively serve its intended purpose. The aesthetics and visual elements should stem from the practical requirements and functionality of the design, rather than taking precedence (Kumar & Noble, 2016). Although not a formalized rule, the concept of prioritizing functionality over form remains relevant in educational technology. Neglecting this FFF principle leads to extensive research on how tools can enhance teaching and learning, as highlighted by Bond et al. (2019), and a deficiency in theory development, as noted by Hew et al. (2019).

Educational technology, as a field at the intersection of technology, learning, design, and communication (Bond et al., 2019), embodies rapidly expanding terminology (Dağhan & Gündüz, 2022) and research topics. For example, some technology-based learning concepts, such as online learning, e-learning, Web-based learning, computer supported learning, computer assisted learning, virtual learning, and distance learning are sometimes used interchangeably. As criticized by Moore and colleagues (2011, p. 129), these "terms are often interchanged without meaningful definitions [as a result], it is difficult for researchers to perform meaningful cross-study comparisons and build on the outcomes from the previous studies." As suggested by Castañeda and Selwyn (2018, p .8), educational technology tools and concepts in higher education require "an ongoing suspicion and skepticism" to better understand the nature of technology-based learning concepts in a viable, credible, balanced, and sustainable approach.

The complexity of emerging technologies and their impact on the fabric of our society as well as our bodies, cultural norms, discourses, and social interactions are becoming increasingly profound (Adorno, 2018). For example, the wearable technologies have turned the human body into a part of technology resulting in shifting human interactions with machines and the world (Tavakoli et al., 2020). As for the shifting discourse, for instance, the expressions like "You are on mute!" or "Can you see my screen?" are presently associated with a virtual meeting after the global adoption of video conferencing tools due to the COVID-19 pandemic. Novel social issues also generate new educational technology language such as emergency remote teaching (Whittle et al., 2020), Zoombombing (i.e., hijacking a Zoom videocall), virtual background, and send everybody to the breakout rooms, to name a few. Therefore, sustainable terminology development in the field of educational technology is crucial in promoting a holistic and responsible approach to its development and implementation.

The dictionary definition of sustainability is "the degree to which a process or enterprise is capable of being maintained or continued without causing the long-term depletion of natural resources" (Oxford English

Dictionary, 2023). Although the notion of sustainability is closely linked to environmental studies, it has also been examined through different lenses, including philosophical, economic, historical, political, social, and cultural perspectives (Stepanyan et al., 2013). The term sustainable development on the other hand refers to "integration, and understanding and acting on the complex interconnections that exist between the environment, economy, and society" (Drexhage & Murphy, 2010, p. 6).

According to Sterling (2014), foundational qualities of education for sustainable development encompass contextual awareness, innovation, holistic thinking, integrative approaches, critical reflection, balance, systemic understanding, ethical considerations, purposiveness, inclusivity, and a commitment to lifelong learning.

In educational technology, where terms and tools evolve dynamically, a sustainable use of language is imperative (Dağhan & Gündüz, 2022; Moore et al., 2011). Attaining sustainability in this context requires cultivating an adaptable vocabulary that considers context, while encouraging innovation, critical thinking, and an awareness of broader systemic impacts (Basdogan & Birdwell, 2024). To put it differently, sustainability in educational technology extends beyond linguistic choices to involve purposeful and skeptical inquiry into the pedagogical, social, cultural, political, environmental, and economic implications of digital technology use in education (Castañeda & Selwyn, 2018).

This study investigates the written discourse of educational technology scholars with the goal of promoting sustainable terminology usage in the field of educational technology. As the authors of this study, we support sustainable terminology for various reasons. First, it promotes clarity and consistency in communication by enabling educators, researchers, and practitioners to share a common language, thereby reducing confusion and also fostering effective collaboration (e.g., Falck et al., 2022). Second, adopting sustainable terminology contributes to the longevity and relevance of educational technology discussions. Consistent terms facilitate the development of a cumulative body of knowledge, allowing researchers and practitioners to build upon existing work (Cole, 1987). Third, it supports inclusivity and accessibility in education. Clear and standardized language helps bridge gaps between different stakeholders, including educators, students, policymakers, and technology developers (e.g., Turner & Belesky, 2010). Finally, sustainable terminology enhances the credibility and professionalism of the educational technology field.

1.2. Understanding technology-based learning landscapes within the educational technology field

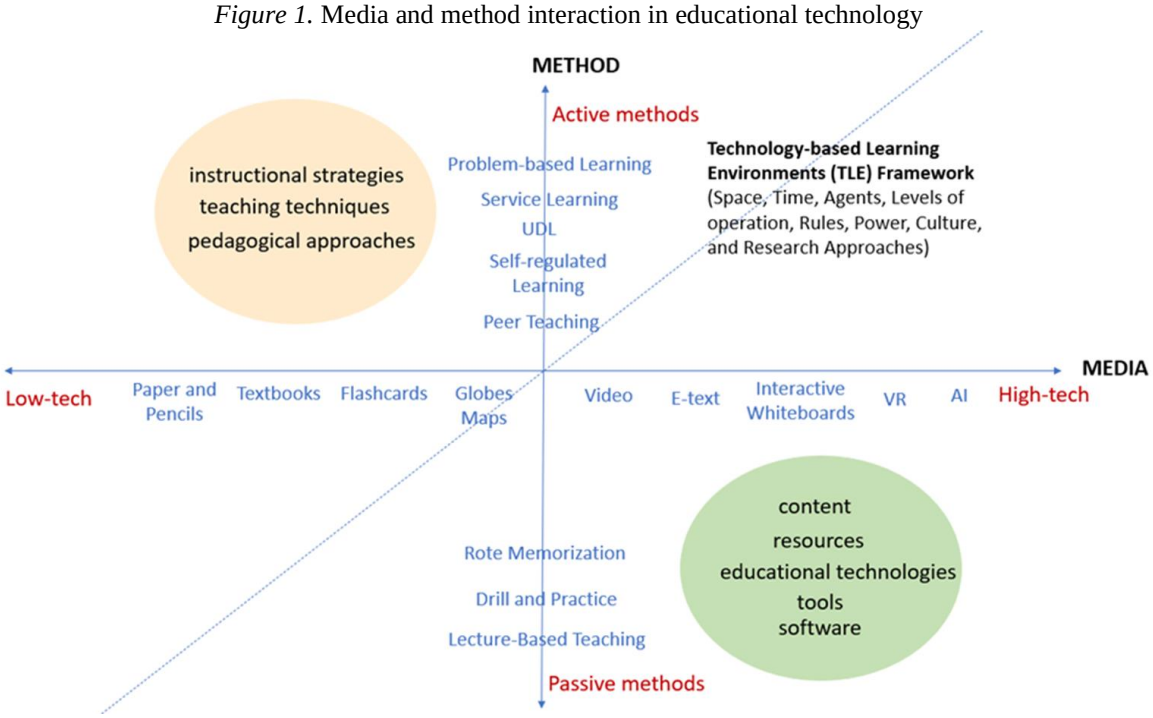
Deleuze and Guattari (1994) indicate that concepts are the core of philosophy. In their collaborative book, *What Is Philosophy?* Deleuze and Guattari (1994) argue that concepts are unstable bridges between the empirical world and thought. Rather than being fixed, concepts reflect the intricacies of knowledge.

In this study, our primary objective was to address how different types of technology-based learning environment concepts such as: (1) online learning, (2) distance learning, (3) e-learning, (4) Web-based learning, (5) virtual learning, (6) computer-supported learning, (7) open learning, (8) computer-aided learning, and (9) computer-assisted learning have been conceptualized and studied in academia by educational technology scholars. The purpose was to promote sustainability in terminology use in the educational technology field. We define sustainability as a holistic and integrated approach that encompasses responsible actions and skeptical inquiry into the pedagogical, social, cultural, political, environmental, and economic implications of digital technology use in education.

Grounding on the foundational qualities of education for sustainability idea (Sterling, 2014), this study proposes a framework named "Technology-based Learning Environments" (TLE) and describes the major dimensions of technology-based learning environments informed by the published educational technology literature.

Educational technology, as defined by the Association for Educational Communications and Technology (AECT, 2023), is the systematic study and ethical application of theory, research, and practices to enhance learning and performance through strategic design and implementation of instructional processes and resources. Educational technology provides the methods (Clark, 1994) and media (Kozma, 1994) for effective learning experience (see Figure 1), while TLE showcases the practical application of these methods and media within the diverse educational context such as online, virtual, open, and distance learning.

Figure 1. Media and method interaction in educational technology



Utilizing a descriptive-interpretive research method, as outlined in the subsequent section, we analyzed various TLEs and their complex components such as: (1) Space, (2) Time, (3) Agent, (4) Level of Operations, (5) Rules, (6) Power, (7) Culture, and (8) Research Approaches. This analysis aimed to holistically understand how different components of TLEs work together and depend on each other to shape the learning experience.

2. Method

A descriptive-interpretive qualitative study design (Merriam & Tisdell, 2015) was followed to explore educational technology scholars' experiences with technology in their written narratives. In total, 191 published doctoral dissertations written between 1985-2018 were the data sources of this inquiry.

2.1. Critical discourse analysis of doctoral dissertations

Norman Fairclough's Critical Discourse Analysis (CDA) (2013) was used to make sense of specific educational technology concepts' definitions and provide the implications of the words, actions, values, and beliefs in the technology-based learning environment knowledge domain through CDA.

In this CDA study, our research material were doctoral dissertations in Turkish national dissertation database written about one of the following concepts: (1) online learning, (2) e-learning, (3) Web-based learning, (4) computer supported learning, (5) computer assisted learning, (6) computer mediated learning, (7) virtual learning, (8) online learning, and (9) open learning.

2.2. Rationale for choosing Turkish doctoral dissertations as data sources

In our study, we utilized doctoral dissertations as data sources for three main reasons. First, as an essential component of the Doctor of Philosophy (Ph.D.) degree, a doctoral dissertation reflects candidates' scientific, original, and professional work that meets the ethical standards of the discipline (Cone & Foster, 1993). Dissertations typically offer flexibility to scholars in terms of word count, writing format, and narrative style.

Second, these intellectual works are collaborative in nature since they are written under the guidance of a dissertation committee who are familiar with the candidate's epistemic view, background, and academic history. This is in contrast to the blind peer-reviewing process common in academic journals. Third, Bozkurt et al. (2016, p. 206) define doctoral research as "gray academic literature" and emphasize the critical role of this gray area in

"creating, distributing, and disseminating scientific" knowledge. As such, in this study, we aimed to go beyond the limitations of academic journals and explore this original gray area further.

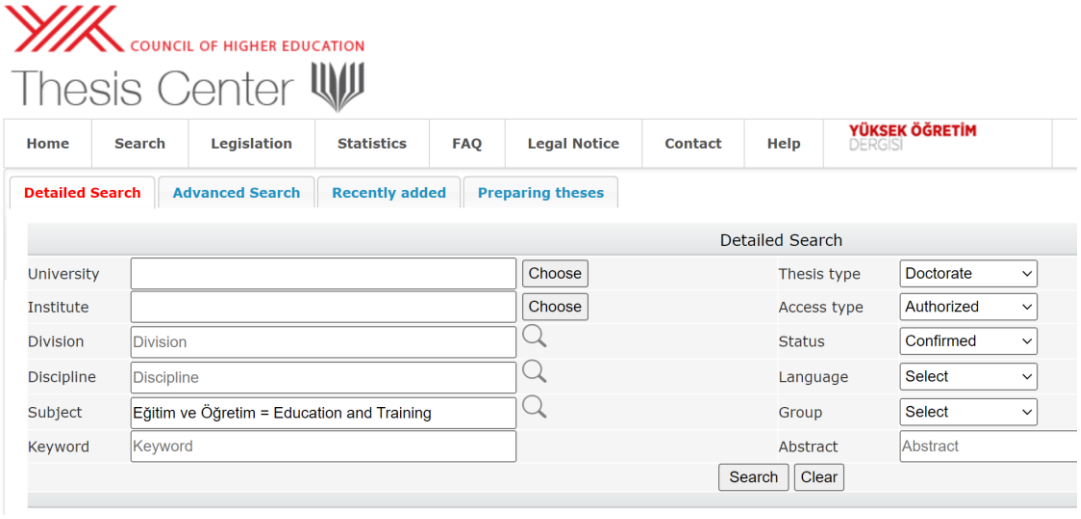
Moreover, the lead author restricted the scope of this study to Turkish doctoral dissertations due to her expertise in the historical, cultural, and educational context related to educational technology in Turkey.

2.3. Data retrieval

The dissertations were retrieved from the thesis database of the Turkish Council of Higher Education. The language of the dissertations varied based on the institutional norms and requirements (i.e., Turkish and English). However, all submitted dissertations had both Turkish and English titles and abstracts regardless of the institution. Therefore, the data inclusion process started with the title and abstract reviews.

First, the thesis type was limited to "Doctorate" and the "Education and Training" category was selected as subject area (see Figure 2).

Figure 2. A screenshot of the Turkish Council of Higher Education dissertation database



The following keywords presented in Table 1 have been searched separately.

Table 1. The number of dissertations in each conceptual category

Conceptual category	Count
Computer Aided Learning/Education	12
Computer Assisted Learning/Education	35
Computer Supported Learning/Education	8
Distance Learning/Education	55
E-learning	22
Online Learning/Education	26
Open Learning/Education	6
Virtual Learning/Education	4
Web-based Learning/Education	108
Total	276

Among 276 dissertations, the studies with available full text were downloaded from the website of Turkish Higher Education Council (YÖK) and transferred to the reference management program Mendeley (https://www.mendeley.com/).

First, 235 full text available dissertations in the PDF format initially were analyzed based on their descriptive features. During the analysis 44 dissertations were also excluded from the analysis since they were not relevant to the educational domain. After those deletions, a total of 191 dissertations were analyzed in terms of descriptive variables using a MS Excel sheet. The variables included: (1) Author name, (2) Department and School, (3) Dissertation Title, (4) Year, (5) Abstract, (6) Research Topic, (7) Research Questions, (8) Research Design, (9) Study Participants, and (10) Definitions. Second, the content of the "Definitions" category was

transferred to a new MS Excel document to prepare data for the CDA. In total, 105 definitions were extracted from hundred ninety-one (191) dissertations (see Appendix A).

2.4. Structuring and generating the coding categories

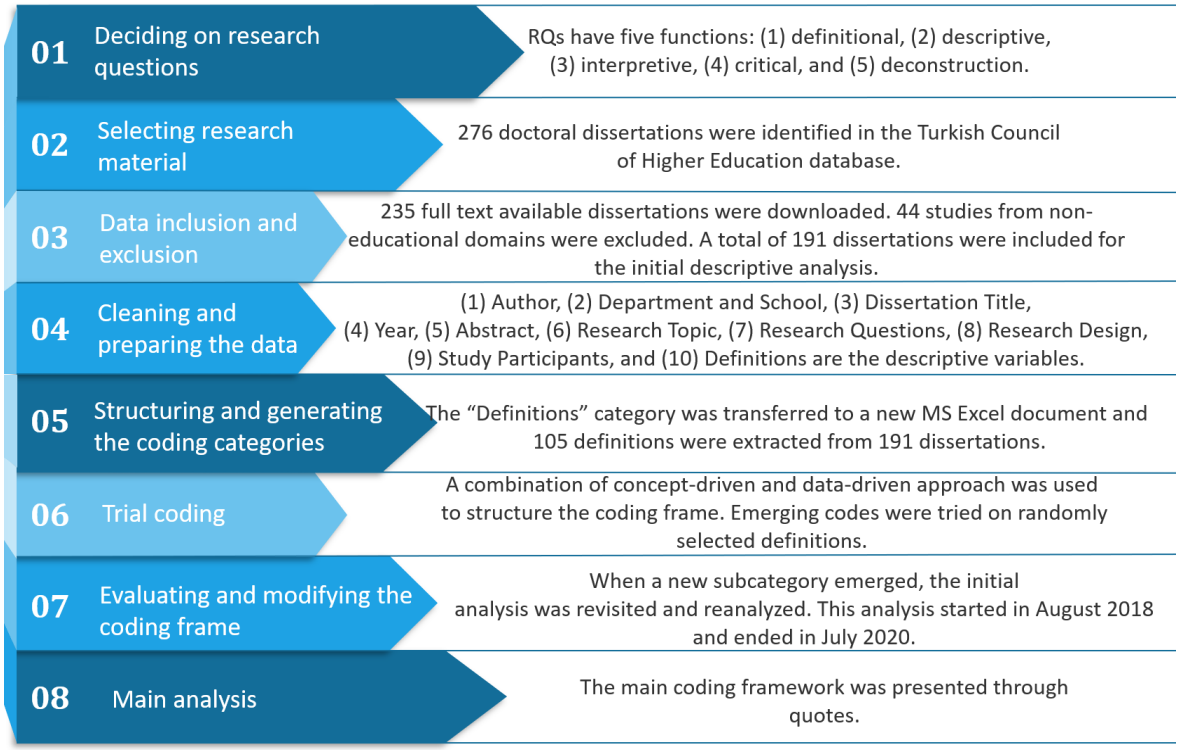
The main categories and sub-categories were structured using a combination of deductive (i.e., concept-driven) and inductive (i.e., data-driven) approaches. Deductive categories were informed by the previous literature on theories and practices in online and distance education. For instance, distance education is often conceptualized as "formal, institutionally based educational activities where the learner and teacher are separated from one another, and where two-way interactive telecommunication systems are used to synchronously and asynchronously connect them for the sharing of video, voice, and data-based instruction" (Simonson, 1995, p. 106). Using this argument as a departure point, we decided to explore the definitions in our data pool inductively in terms of how they define the "space," "time," "agent," "power," and "level of operation" in each conceptual category.

In a similar vein, Foks (1987) argued that open learning is "an approach taken to the planning, design, preparation and presentation of courses by educators" (p. 76). This argument regarding open learning in terms of the roles of instructor as well as instructional activities lead us to add "rules" and "culture/norms" categories to our coding framework.

Once the main categories are structured, we started testing these seven categories in randomly selected definitions from the data pool. To increase the rigor of the coding framework, we regularly discussed the evolving framework with our colleagues for about one year.

Most of the sub-categories emerged directly from the data without interpretation. When we came across a new subcategory, we revisited the initial analysis and reanalyzed the definitions based on the new subcategory. This labor-intensive analysis started in August 2018 and ended in July 2020. To be systematic and consistent while attempting to stay organized, we used a codebook having concise descriptions of each category and subcategories as well as representative examples of each. Figure 3 presents the visual summary of the analytical steps that were followed to analyze the discourses of the 105 definitions in nine conceptual categories.

Figure 3. The steps of critical discourse analysis of conceptual definitions



3. Findings

To describe the nature of a technology-based learning environment, the CDA of one hundred-five conceptual definitions in 191 selected doctoral dissertations suggested the following seven core themes used by the scholars whose dissertations were included in this study: (1) Space, (2) Time, (3) Agent, (4) Level of Operations, (5) Rules, (6) Power, (7) Culture, and (8) Research Approach. Notably, the definitions typically came from the literature review chapters and the operational definitions of the authors of these dissertations.

3.1. "Space" in the discourses of the conceptual definitions

In examining how educational technology scholars define the learning space for each conceptual category, the first theme emerged as "Space." We searched for both concrete and abstract keywords defining the learning space, such as environment, setting, area, location, context, domain, and realm. The results revealed that the learning spaces are defined in four main formats: (1) Transcendent Space, (2) Immanent Space, (3) Actual Space, and (4) Virtual Space.

Table 2. The descriptions and examples of the space categories and sub-categories

Categories	Subcategories	Examples
Space: *The area /location/ distance/ realm/ domain where teaching and learning activities take place.*	Transcendence: Theoretical space such as learning model, education system, teaching approach.	"Web-based learning is an innovative and sustainable *learning method*." [Transcendence]
	Immanence: Action-based space such as the use of computers, educational activities.	"E-learning is *the use of* telecommunication technologies to distribute information for educational activities." [Immanence]
	Actual: A reference to the concrete existence of the space informed by the use of specific words such as tools, setting, location, and environment.	"CLS is a training with computer presentation, CDs and floppy disks, and interactive applications. [Actual]
	Virtual: A space character that does not physically exist such as innovative, flexible, sustainable, and efficient.	"Web-based learning is an *innovative and sustainable* learning method." [Virtual]
	N/A: Non mention of space.	

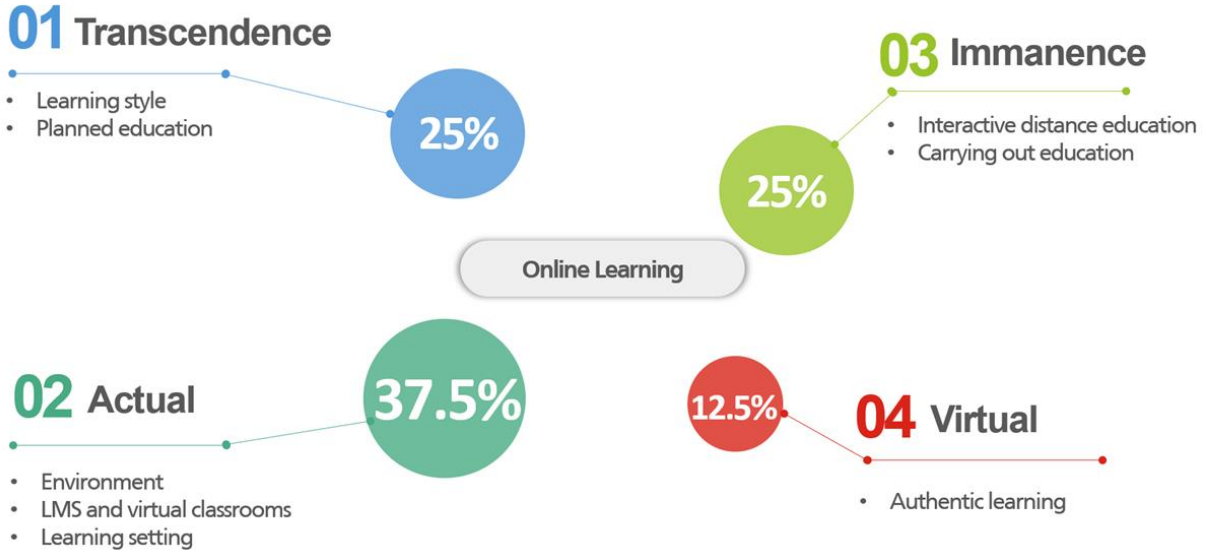
In our codebook, we operationalized the Transcendent Space as a theoretical space. Any learning modality that was defined as a learning model, education system, or teaching approach was categorized under the transcendent space sub-theme. For instance, when scholars defined "Web-based learning as an innovative and sustainable learning method," we classified it as part of the Transcendent Space because they perceived and defined it as an abstract and philosophical concept, using the term "learning method."

The second sub-theme, Immanent Space, referred to activity-based space. We borrowed these two labels; Transcendence and Immanence from Deleuze's (1994) book, Difference and Repetition, that discusses ontological requirements for "being" and "becoming." For instance, in the following definition, "E-learning is the use of telecommunication technologies to distribute information for educational activities" the scholars emphasize an activity (i.e., "the use of" telecommunication technologies) in their e-learning definition.

Next, Actual Space connoted concrete space associated with tools, technologies, and physical environment. In the following definition of Computer Supported Learning (CLS), "CLS involves training with computer presentations, CDs and floppy disks, and interactive applications." In effect, the researchers emphasized the actual space involving the use of tangible tools and resources (i.e., computer presentation, CDs and floppy disks, and interactive applications) in addition to the theoretical space (i.e., training).

Finally, Virtual Space reflected non-physical space characteristics such as being innovative, flexible, sustainable, and efficient. Although it might be deemed similar to theoretical space, virtual spaces do not necessarily reflect a theoretical background. Table 2 presents each of these four space types with examples. One conceptual definition can include multiple space types at the same time.
First, in the online learning definitions, it was found that the aspect of "Actual" was highlighted most (37.5%) and followed by the aspect of "Transcendence" (25%) and "Immanence" (25%). Virtuality was the least emphasized aspect (12.5%). Figure 4 presents the percentages of the sub-categories with examples.

Figure 4. Space aspects in the "online learning" definitions



For example, Akbiyik (2012) defined online education as follows: "The systems, called online education, are **internet-based educational environments** that enable students, classmates and materials to be accessed through online communication tools" (p.14) [Emphasis added]. In his definition, the emphasis on the communication tools and educational environments refers to the aspect of "Actual" that reflects online learning as a combination of physical elements.

Second, it was found in the distance education definitions that the aspect of "Transcendence" was highlighted most (44.1%) and followed by the aspect of "Actual" (38.2%), "Immanence" (8.8%), and "Virtuality" (8.8%).

For example, in his dissertation over three decades ago, Özer (1989) defined distance education as "the product of efforts to provide **alternative educational opportunities**" (p. 5) [Emphasis added]. The "education opportunities" which is a broad and abstract notion of distance education was listed under the "transcendence" category. Moreover, the term "alternative" was listed under the "virtual" category since it refers to an abstract feature of the space.

Next, in the computer-aided learning (CAL) definitions, it was found that the aspect of "Actual" was highlighted dominantly (44%) and followed by the aspect of "Immanence" (33%) and "Transcendence" (22%). "Virtuality" was not identified in CAL definitions.

For instance, in her dissertation, Asan (1998) defined that computer-aided learning "is the use of the computer as a tool in a learning and teaching environment" (p. 3). In this description, the keywords "tool" and "environment" are labeled under the "Actual" aspect of the space category. Moreover, Hancer (2005) emphasized on the "Immanence" and "Actual" aspects of the space in the following quote: "Computer-aided teaching **is a teaching process** (Immanence) to increase the motivation of the students and keep their interest in the course alive for a long time by providing individual work via **computer technology and personal lesson plans** (Actual)" (p. 13) [Emphasis and descriptions in parentheses added].

Then, in the computer-supported learning (CSL) definitions, similar to the CAL definitions, the "Actual" aspect was found more prevalently emphasized (55.6%) and followed by the aspect of "Immanence" (33.3%), and "Transcendence" (11.1%). "Virtuality" was also not identified in this conceptual category.

For instance, in the dissertation by Turhan (2005), she emphasized the tool-oriented and action-oriented aspect of the CSL in her description as presented in the following quote: CLS is a training with **computer presentation, CDs and floppy disks, and interactive applications**. (Actual) Various documents and photos can be sent by including **cameras** and **scanners** (Actual). [Emphasis and descriptions in parentheses added]

The next conceptual category is computer-assisted learning. It was found that the most dominant aspect of the space is "Immanence" (66.7%) and followed by the aspect of "Actual" (16.7%) and "Transcendence" (16.7%). As with CSL, "Virtuality" was also not identified in this conceptual category.

For example, the discourse of Pilli (2008) pointed out to the "Immanence" aspect of the concept by listing the functions of the computer-assisted learning: "a narrower term and most often refers to use of computers to present drill-and-practice, tutorial, or simulation activities offered either by themselves or as supplements to traditional, teacher directed instruction" (p. 16).

As for the next conceptual category, e-learning, it was identified that the most dominant aspect of the space is "Transcendence" (37.5%) and followed by the aspect of "Actual" (25%), and "Immanence" (25%), and "Virtuality" (13%). For example, Kantaglu (2012) emphasized the "Transcendence" aspect by defining e-learning as "a method of distance education in which teaching services to students, teachers and other users are offered through a web-based system" (p. 14). In this definition, the "Actual" aspect has also been addressed by the use of "web-based system."

Next, in the open learning category, the authors used the term "open and distance education" together. Only one author used the "open learning" without the "distance" component. It was found that the aspects of the "Actual" (33.3%) and "Immanence" (33.3%) were equally emphasized and followed by the "Virtuality" (16.7%) and "Transcendence" (16.7%).

The next conceptual category is Web-based learning. It was identified that the "Immanence" (48%) was the dominant aspect emphasized by the scholars. Then, the "Actual" (28%), "Transcendence" (12%), and "Virtual" (12%) aspects were addressed.

The last conceptual category analyzed based on the space types is virtual learning. Among all conceptual categories, the least number of definitions (n = 2) was found in the virtual learning category. In addition, both definitions described virtual learning environment rather than virtual learning. Therefore, the aspect of "Actual" (67%) was the dominant aspect of space. It was followed by "Immanence" (33%). For instance, Ozkan (2016, p. 5) argued that virtual learning environment is a system (Actual) designed for particular actions (Immanence).

3.2. "Time" in the discourses of the conceptual definitions

After examining all definitions in terms of the conception of "Space," in the next step, we analyzed how the authors described "Time" in the definitions. Interestingly, as detailed in Table 3, 71.4% of the examined definitions did not indicate any time-related information.

Table 3. Time category and its sub-categories with count and percentage

Time	Count	Percentage
N/A	75	71.4%
Linear and/or Nonlinear	23	21.9%
Process	4	3.8%
Repetition	2	1.9%
Total	104	100.0%

Table 4. The number of linear/nonlinear time descriptions in each conceptual

Conceptual category	Count
Computer-Aided Learning	0
Computer-Assisted Learning	1
Computer-Supported Learning	1
Distance Education/Learning	6
E-learning	4
Online Learning	2
Open Learning	4
Virtual Learning	0
Web-based Learning	5
Total	23

Nevertheless, 21.9% of them used linear and non-linear. The descriptions including the words such as "synchronous/asynchronous," "without time limitation," "at the same time," "in different time," and "regardless of time" were coded under the linear and nonlinear categories. Table 4 details the counts of the linear and/or nonlinear conception of time by conceptual category.

Next, the process was identified in 3.8% of the definitions. The expressions referring to a specifically defined time internal was coded under this category. For example, Sulukcu (2011, p. 101) specified that "computer-assisted learning is the presentation of the audio, visual, and video materials in class to support teachers." Similarly, Akpinar (2006, p. 6) argued that computer-assisted learning is "the use of computers in teaching and learning **processes**…"

Finally, in 1.9 % of the definitions, the time was described as repetition. The aspect of being repetitive is associated with reinforcement-related behaviors and moments. Both definitions were found in the computer-assisted learning category. For example, Ilic (2018, p. 22) stated that "computer-assisted learning is defined as the use of computers in order to teach learners a subject or **to reinforce** pre-adopted behaviors."

3.3. "Agent" in the discourses of the conceptual definitions

The next category, Agent, is concerned with the actors in the learning environment (see Table 5). Each definition was examined in terms of the existence of Human and Posthuman actors. In this analysis, the human category refers to individuals and groups in the learning and teaching process, whereas the posthuman category represents entities beyond the human body including interactions, interfaces, technological process, and information systems.

Table 5. The most frequently addressed agents in each conceptual category

Concepts	Agent (the most frequent)
Online Learning	• *Human:* Students • *Posthuman:* Communication technologies and learning materials
Distance Education	• *Human:* Instructor • *Posthuman:* Telecommunication technologies and instructional resources
Computer-Aided Learning	• *Human:* Students • *Posthuman:* Computers
Computer-Assisted Learning	• *Human:* Students • *Posthuman:* Computers
Computer- Supported Learning	• *Human:* Students • *Posthuman:* Computers
E-learning	• *Human:* Students • *Posthuman:* Internet and digital resources
Web-based Learning	• *Human:* N/A • *Posthuman:* Web technologies
Open Learning	• *Human:* Learners • *Posthuman:* Learning resources and communication technologies
Virtual Learning	• *Human:* Students • *Posthuman:* Assessment, communication, content, and environment

3.4. "Level of Operation" in the discourses of the conceptual definitions

The levels of operation, which is the scale of the learning and teaching activities, is the next category identified in this critical discourse analysis. Analysis results showed that there are three scales in which each conceptual category operates: (1) Macro, (2) Meso, and (3) Micro.

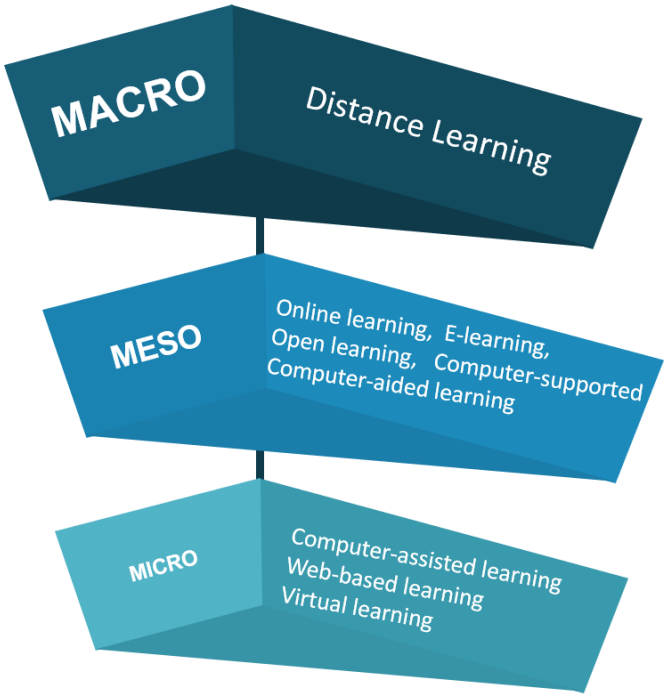
The macro level refers to large scale learning and teaching notions such as "educational systems and formal education." Second, the meso level discusses medium level operations such as "process, approach, technique, models, style, type, and method." Third, the micro level concerns with small scale and very specifically defined learning or teaching "environment, platforms, settings, activities, resources, practices, and tools." Accordingly, the frequency of the three levels with keywords are presented below concept by concept.

Interestingly, the Macro operational level was identified only in the distance learning definitions. The authors defined this form of learning as a system or formal education.

In contrast, the Meso operational level was identified in the online learning, computer-supported learning, computer-aided learning, e-learning, and open learning categories. This level included learning or teaching related terms, such as: process, approach, technique, models, style, type, and method.

Finally, the Micro operational level operation was identified in the computer assisted learning, Web-based learning, and virtual learning. The definitions in these categories pointed out to specific learning and teaching related activities, environments, settings, platform, resources, practices, and tools. In Figure 5, the terms are grouped based on their level of operation.

Figure 5. Levels of operations of the nine concepts



3.5. "Rules" in the discourses of the conceptual definitions

"Rules" refer to the form and structure of the learning and teaching environment. Figure 6 details the identified rules in each conceptual category.

The state of being deliberate or purposive, "Intentionality" has been identified in all conceptual categories except "Open Learning." For instance, the expression "it is a **planned** …" was interpreted that it is an intentional teaching/learning/educational activity.

Similarly, the state of being constructed according to pre-planned objectives, "Being structured" is another rule identified in seven conceptual categories except "Computer-aided learning" and "Web-based learning."

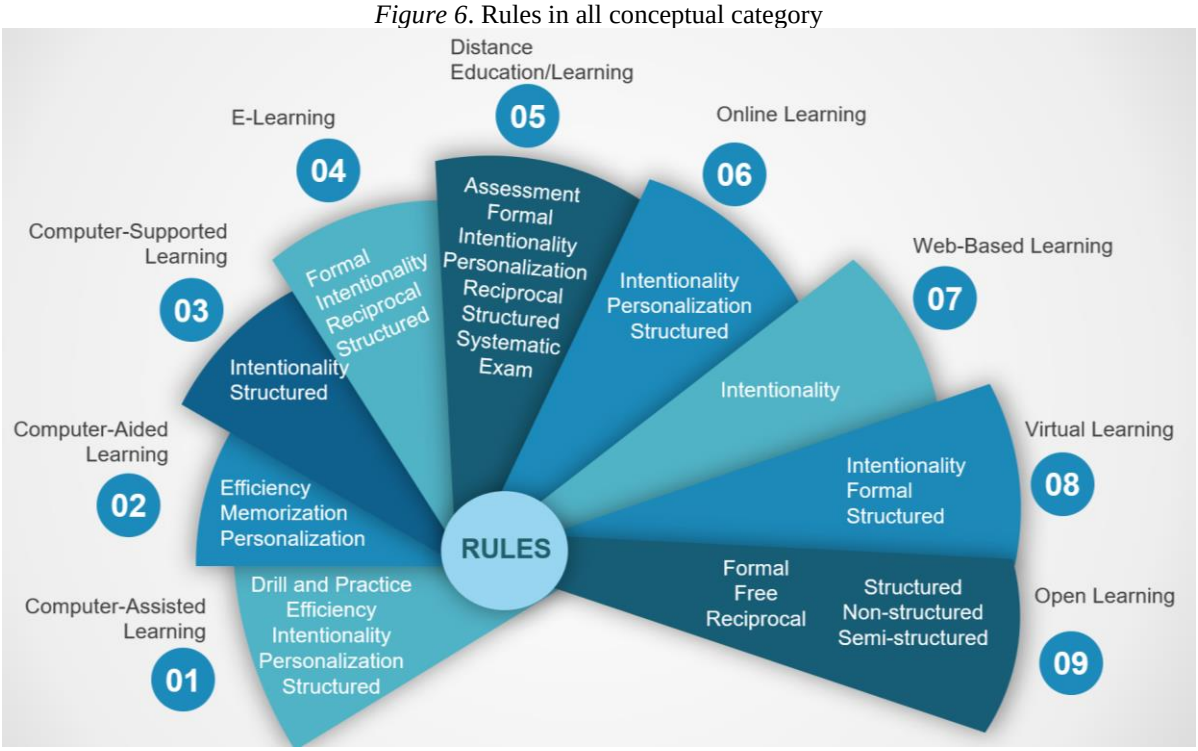
Next, the two-way communication to exchange ideas and course materials, "Reciprocity" is identified in "E-learning," "Open learning," and "Distance learning." The keywords, **feedback** and **two-way communication** were coded under reciprocity between the learner and the instructor.

The act of tailoring the instruction based on the individuals' needs and availability, "Personalization" was found in the "Computer-assisted learning," "Computer-aided learning," "Distance education," and "Online learning" conceptual categories. The existence of the expressions such as **customized to the individual learning pace, speed, availability,** and **ability** was coded as personalization.

Next, aspects of **performance improvement** were found in two conceptual categories. For example, the act of rehearsing a subject over and over that is "Drill and Practice" was identified in the "Computer-assisted learning." Similarly, in the "Computer-aided learning," "Memorization" was emphasized as a rule of the learning environment. Also, the rule of being "Efficient" was also identified only in these two categories.

In addition, the rule of being "Systematic" was only identified in the "Distance education" whereas being "Free" was only mentioned in "Open learning." Finally, the aspect of being "Formal" was highlighted in both "Distance education" and "Open learning."

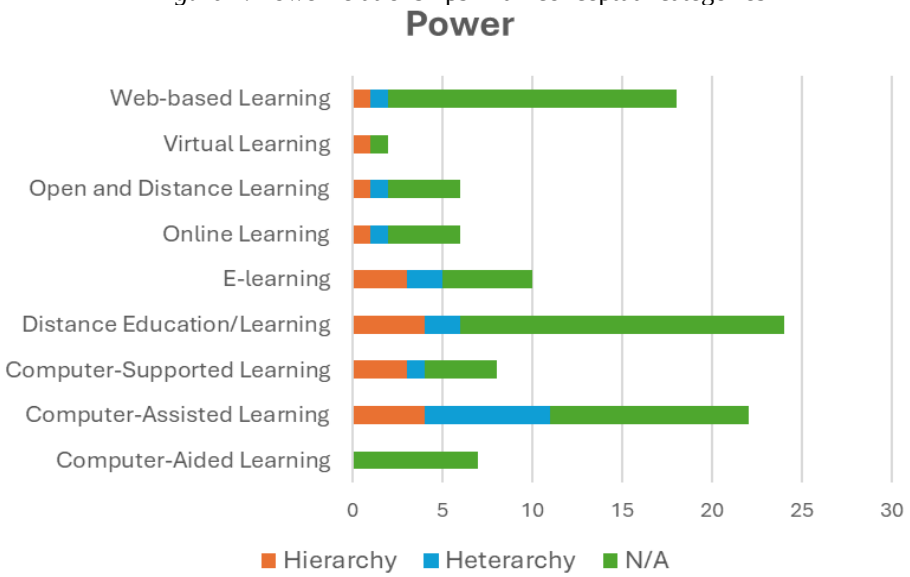
Figure 6. Rules in all conceptual category



3.6. "Power" in the discourses of the conceptual definitions

The "Power" category concerns with the socially created and assigned roles to the human actors in the learning and teaching environment. The analysis identified two types of relationships: (1) Hierarchy that refers to existence of a ranking between actors and (2) Heterarchy that is the unranked and flexible relationships between the actors. Figure 7 presents the number of the power categories on a bar graph.

Figure 7. Power relationships in all conceptual categories



The data indicated that most of the definitions (65.6%) did not include a keyword addressing the power relations. In addition, 18.8% of the definitions indicated the existence of a hierarchic relationship, while 15.6% address the heterarchical relationships.

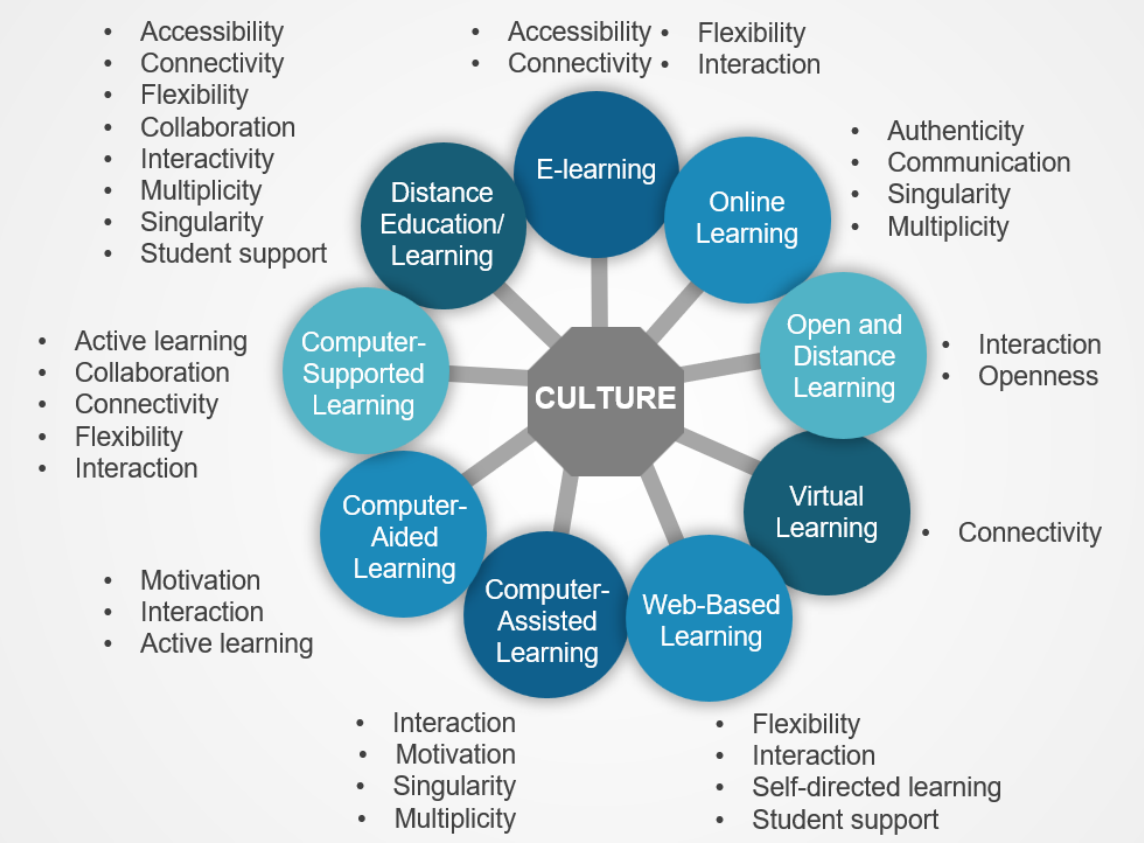
Distance learning was the category that included a majority of hierarchical relationships. The existence of keywords such as "exam," "formal," "institution-based," "designers-implementers," "students," and "system administrator," and naming the participants as "student/teacher," rather than "learner/guide" were interpreted as indicative of hierarchic interaction. In addition, in computer-assisted learning, the expression "under the teacher guidance;" in open learning, the keyword "sender and receiver;" in computer-supported learning, the phrase "teacher-centered instruction;" and finally in virtual learning, the sentence "the administration of the student groups" were all interpreted as indicators of hierarchic power relationships.

Computer-assisted learning, on the other hand, was found to have the majority of the heterarchical relationships. The expression "learn by yourself" was repeated in seven definitions in computer-assisted learning. In addition, the phrases such as "student autonomy" in computer-supported learning; "collaboration, support, and guidance" in distance education; "student-centered and student groups" in e-learning; "improving human experiences" in online learning; "studying together and learn by yourself" in Web-based learning; and "learning without the presence of a formal instructor" in open learning were grouped as an unranked and flexible community relationship.

3.7. "Culture" in the discourses of the conceptual definitions

Finally, the "Culture" is an umbrella term that encompasses the social dynamics, principles, and norms of learning and teaching situations. Figure 8 displays the identified culture-related expressions in each conceptual category.

Figure 8. Cultural components of all conceptual categories



Distance education seemed to have most of the variety in terms of community culture. The findings included accessibility, connectivity, flexibility, collaboration, interactivity, multiplicity, singularity, and student support. To better understand these findings, quotes related to the definitions for some of the cultural elements are presented below.

- Distance education is extended by the *student support services* (Ozer, 1989, p. 6). [Student support]
- …distance education programs provide *education opportunities* to people who are not enrolled in any educational institution (Irmak, 2007, p. 17). [Accessibility] [Emphasis added]

- … distance learning is an *individualized* form of learning (Karaaslan, 2008, p. 14). [Singularity] [Emphasis added]
- Distance education brings the learner and instructor together… (Dursun, 2011, p. 36). [Multiplicity]
- In distance education, communication technologies enable the interaction between the learners, instructors, and resources (Kocdar, 2011, p. 5). [Interactivity]
- Distance education is defined as a learning and teaching approach based on the use of internet technologies for the purpose of communicating and developing cooperation in educational activities (Tufan, 2013, p. 130). [Collaboration]
- Distance education allows recipients individuality, flexibility, and independence in terms of age, objectives, time, location and management, etc. (Celik, 2017, p. 54). [Flexibility]

It is important to point out that collaboration, active learning, singularity, multiplicity, flexibility, and connectivity are also emphasized in many other conceptual categories.

3.8. Research approaches

Scholars' position to the nature of knowledge within their dissertations is detailed and explored by the analysis of the research paradigms. According to Kuhn (1962, p. 47), "paradigms guide research by direct modelling as well as through abstracted rule." These rules and assumptions are agreed on by the scientists.

In all conceptual categories, quantitative research was found to be the dominant paradigm followed by the scholars. Analysis also showed that "What questions" that deal with describing or comparing situations within a value-free framework were predominantly asked. In contrast, the "How questions" that aim to explore or investigate a phenomenon were used scarcely. However, the qualitative paradigm gained acceptance after 2014.

In addition, academic achievement, student success, and student performance were the most popular research topics among Turkish scholars in the majority of the conceptual categories The popularity of the "success" was not only observed in the dissertations from open learning field. Printed material design, graphic and website design, interactive TV, mentoring, and evaluation were the main research topics studied in the open learning (see Table 6).

Table 6. Descriptive analysis of the research approaches

Conceptual Categories	Number of Studies	The Most Frequently Studied Department /Program	Years	The Most Frequently Studied Research Topics	Research Questions	Research Paradigms
Online Learning	18	Computer education and instructional systems technology	2007-2018	Academic achievement, success, and performance	What:108 How:12 Hyp:26	Quan:11 Mixed:6 Qual:1
Distance Education	48	Department of distance education	1989-2018	Academic achievement and success	What:135 How:47 Hyp:22	Quan:21 Mixed:16 Qual:8 Design&Devl:3
Computer-Aided Learning	12	Miscellaneous (Learning science, math, geography, science, art, religious science, physical education, informatics, and technology education)	1998-2018	Learning and teaching in a specific subject (e.g., math, science, biology, etc.), student achievement, and success	What:46 How:6 Hyp:14	Quan:8 Mixed:3 Qual:1
Computer-Assisted Learning	30	Miscellaneous (Computer education and instructional technology, math, science, language	1999-2018	Teaching a specific subject (e.g., music, science, grammar, physical education, etc.),	What:189 How:18 Hyp:80	Quan:25 Mixed:3 Qual:2

		teaching, physical education, fine arts, music education, elementary teaching, and computer engineering		student achievement, and student attitudes		
Computer-Supported Learning	7	Miscellaneous (Department of fine arts, computer education and instructional systems technology department, department of secondary science and mathematics)	2009-2018	Collaborative learning, self-efficacy, and achievement	What:40 How:2 Hyp: N/A	Quan:4 Mixed:3 Qual: N/A
E-learning	15	Miscellaneous (Department of computer education and instructional technologies, business administration, department of curriculum and instruction)	2011-2018	Achievement, satisfaction, data mining, and learning analytics	What:51 How:5 Hyp: 22	Quan:10 Mixed:5 Qual: N/A
Virtual Learning	4	Department of educational sciences, English language teaching, department of educational research, and computer education and instructional technology	2004-2014	Community of inquiry framework, collaboration, and achievement	What:21 Hyp: 14	Quan:2 Mixed:2
Web-based Learning	50	Computer education and instructional technology departments and health sciences	2001-2018	Achievement and success, attitude, nursing, and diabetes, self-efficacy health education self-care, and reflective thinking	What:175 How:11 Hyp:82	Quan:31 Mixed:15 Qual: 4
Open Learning	8	Department of business, cinema and TV, English language education, and department of distance education	1985-2018	Printed material design, graphics design and website design, measurement and evaluation, interactive TV, and mentoring	What:14 How:6 Hyp:2	Quan:5 Mixed:2 Descriptive Document Review:1

4. Discussion

Education for sustainability (EFS) addresses modern crises by grounding itself in contextual understanding from local to global levels (Sterling, 2014). It embraces innovation, holistic approaches, and interdisciplinary inquiry

while maintaining ethical awareness. EFS aims to reconcile dualistic paradigms, foster systemic thinking, and promote inclusivity and lifelong learning for all as argued by Sterling (2014).

As society and technology progress, certain concepts and accompanying terminologies, such as Generative AI, gain popularity while older terms such as floppy disc naturally fade away. In this study, sustainability is defined as the purposeful and skeptical inquiry into the pedagogical, social, cultural, political, environmental, and economic implications of digital technology use in education (Castañeda & Selwyn, 2018). While the names of technological objects may change, we have strived to develop a framework for evaluating technological activities, technological knowledge, and technological volition across contextual and holistic levels (Basdogan & Bonk, 2023).

We examined scholars' discourse on the use of terminologies such as: (1) online learning, (2) distance learning, (3) e-learning, (4) Web-based learning, (5) virtual learning, (6) computer-supported learning, (7) open learning, (8) computer-aided learning, and (9) computer-assisted learning. Although these concepts are sometimes used interchangeably, the study found explicit and implicit differences in how educational technology scholars used and defined them in terms of space, time, agents, levels of operation, rules, power, culture, and research approaches aspects.

4.1. Space and human-technology relationships

The "Space" analysis was carried out to identify how technology mediates human experience in each conceptual category. As argued by Ihde (2009), three types of human-technology relationships have been captured in terms of space use, including: (1) embodiment relations where individuals are considered as "one" with the technology and we use them without thinking about them, (2) alterity relations where the technology becomes "the other" and we have the experience of interacting with someone else such as in our relationship with the digital assistants and robots, and (3) background relations which relates to when technology both structures and transforms our experience. In the latter, however, technology does not occupy the focal attention but operates in the background such as an air conditioner or background music in an instructional video.

Definitions in the distance education and e-learning categories included more transcendence (i.e., theoretical space) type space conceptions such as instructional systems, teaching approaches, alternative education opportunities, institution-based formal education, a form of learning, and an educational model. These expressions seem to include abstract conclusions drawn from experiences and observations. In line with Ihde's background relations, distance education and e-learning are perceived as technologies that operate in the background and influence our educational experience externally without occupying much attention. In addition, the phrase "learning from anywhere and anytime" that was frequently used by the scholars of this study to describe distance education and e-learning strengthens this background relations argument.

Second, the definitions in the computer-assisted learning and Web-based and open learning included more immanence (i.e., action/activity related space) type space conceptions compared to other sub-categories of the space. For example, the use of computers, the act of transferring content via a computer, and using computers as a supplement or an external assistant are some of the extracted phrases from the definitions. These definitions suggest that technology is perceived as an active extension of human cognition (e.g., human body) in the educational process. The software and apps developed for computer-assisted learning and Web-based learning are perceived as "one" with humanity. Notably, human agents experience the world with these technology tools. Therefore, Ihde's embodiment relations, might be an insightful explanation to understand this space-based human-computer interaction.

Third, virtual learning, online learning, computer-aided learning, and computer-supported learning were found to include dominantly actual dimension of the space conception. They define these concepts using expressions such as, educational settings, Internet-based environment, technology-based system, video/audio tools, and learning platforms with computers, cameras, and scanners. The reference to the concrete existence of tools can be related to Ihde's alterity relations where the technology becomes "the other" and the users have the perception of interacting with someone else.

Finally, definitions in the open learning category showed that immanence and actual aspects were equally emphasized. This finding can be interpreted to mean that open learning is a more eclectic form of learning that includes embodiment and alterity relations together.

4.2. Agent: human and posthuman actors

In the "Agent" category, the discourses of the definitions pointed to two different actor types, Human and Posthuman. It is interesting to note that the student actors were identified as the most frequently referred to human agents in online learning, computer-aided learning, computer-assisted learning, computer-supported learning, e-learning, and virtual learning. In contrast, definitions in the open learning used the term learner more frequently. Biesta (2010, p. 541) argues that "…the learner is constructed in terms of a lack. The learner is the one who is missing something. The learner is the one who is not yet complete." Such negative connotations of the word learner include suggestions of inequality and insufficiency. In response, Biesta (2010, p. 544) suggests the use of student as the subject of the education in which "the educator is still there, but not as an explicator, not as a superior intelligence, but as a will."

Also, instructor was the most frequently mentioned human agent followed by the student in the distance education category. The heavy emphasis on the instructor may be explained by the transcendence type space feature. To reduce ambiguity, authors might feel a need to sufficiently describe the roles and functions of instructors in distance education. It could also suggest that the success of distance education is primarily linked to the instructor's success in designing and developing the course, and secondarily to student efforts to learn.

The posthuman agents included both entities beyond the human agents. Online learning, distance learning, and open learning definitions frequently referenced "communication technologies," whereas computer-aided, computer-assisted, and computer-supported learning definitions mainly referenced "computers." This pattern may indicate that two-sided dialogue, interaction, and feedback are crucial for information exchange in the former group, while hardware and software capabilities are more critical in the latter group to achieve learning objectives. This finding may suggest that the boundaries between humans and machines are more visible in the second group compared to the first group.

4.3. Level of operation: macro, meso and micro scales

Three operational levels were identified including Macro, Meso, and Micro scales. This analysis enabled us to identify the strategic goals of each concept as well as their vertical relationships. In a previous terminology analysis, Anohina (2005) examined the linguistic structures (e.g., connectors words) and the use of technologic tools (e.g., Internet, Web, computer, etc.) and categorized eight concepts in a hierarchical sense with circles inside another circles. While this attempt offers a way of understanding the concepts such as computer-based learning, distance learning, e-learning, Internet-based learning, online learning, technology-based learning, and Web-based learning, it simplifies these concepts solely to the medium used to carry out the education. However, each concept is more than the tools. Accordingly, Anohina (2005) disregards the operational, theoretical, cultural, and economical dimensions. In the current study, the CDA suggests an empirical distinction between the technology-based concepts in terms of their reference to systems, processes, or tools.

4.4. "Timeless" concepts and Research paradigms

In the "Time" category the period or moments in which the educational instances or actions happened was investigated. It was interesting to note that majority of the analyzed dissertations did not address the time aspect. The avoidance to use of any word defining time might have two reasons. First, the notion of time can be difficult to define for scholars since it is highly abstract compared to the space or agent. The second possible reason for this issue might be an attempt at avoidance from external critiques. For example, when the duration and progress are clearly defined for each concept, changing the format and modifying the learning and teaching activities in the targeted concept might be difficult for the designers and instructors.

In addition, researchers' heavy reliance on positivism may bias their definition of technology-based learning environments, overlooking the importance of reflexive, caring, and open dialogue, as advocated by Denzin and Lincoln (2011) for interpretive research paradigms.

4.5. Rules: intentionality matters!

To understand the *structure* and *form* of the learning and teaching environment, we examined the discourse of the conceptual definitions. The results first demonstrated that the purpose of the learning space determines the

rules and structure. For example, Intentionality was a common word repeated in all conceptual categories, such as intentional teaching, intentional learning, and planned activities.

Second, distance education was found to include quantitatively more rule-related words in the definitions. Intentionality, personalization, reciprocal relations, and being systematic, formal, and structured are some of the rule-related words used. Hence, it could be hypothesized or argued that distance education is a more eclectic form of learning among all conceptual categories since it involves the features of both formal, informal, self-directed, co-directed, institution-based and individual-centered learning and teaching modalities.

Third, Web-based learning had the fewest rules compared to other categories. This may be due to the fact that scholars from multiple disciplines studied it for task-based purposes, resulting in tailored design-based approaches and a scarcity of general rules for Web-based learning.

4.6. Power relations and culture: Heterarcy versus hierarchy

We also analyzed the socially created and assigned roles to the subjects of the education in the discourse of the definitions. In this analysis, we focused on the power relations between the stakeholders of the environments to better understand to what extend the feelings, experiences, thoughts, and opinions of the learners are addressed and expressed in these conceptual categories. Analyses showed that most of the definitions did not address power at all.

It is not surprising that the majority of the hierarchic relationships were found primarily in the distance education definitions. Due to its structure as explained under the Rules section, the words such as institution-based, requiring an exam, certificate, formal learning, and system administrator were interpreted as the hierarchy power relations. Even calling the subject of the education as teacher/student or sender/receiver rather than learner/facilitator was observed as a sign of hierarchy. A similar pattern was also noted in the computer-assisted and e-learning definitions due to the expressions such as teacher-centered instruction or the administration of the student groups.

Finally, the critical discourse analysis of the definitions suggested that the social dynamics and norms of the learning and teaching environments in the conceptual categories showed some similarities and divergences. For example, collaboration, active learning, singularity, multiplicity, flexibility, and connectivity were the cultural elements identified in most of the conceptual categories.

5. Limitations

Study limitations include the fact that there are likely many relevant studies not captured due to specific inclusion and exclusion criteria. In addition, readers must be cautious when applying findings to other contexts due to cultural and social differences. Simply put, if this study were conducted in another country or region of the world, the results may have been quite different.

6. Conclusion and practical recommendations

Technology-based Learning Environments (TLE) framework suggests an approach for how to better understand the nature of technology-based learning contexts by questioning the space, time, agents, levels of operation, rules, power, culture, research approaches, and other aspects in a consistent way. It would help instructors, students, designers, and program evaluators to gain a clear awareness of physical, social, temporal, and cultural components of any technology-based learning settings and provide a sustainable linguistic tool for educational technology researchers and designers.

For example, in a distance education program, the purposeful incorporation of asynchronous discussion forums and collaborative projects to accommodate learners from different time zones (non-linear time), an AI mentor to guide learners in terms of frequently asked questions (post-human agent), and encouraging peer interactions (human agent) to facilitate cross-cultural discussions and collaborations (culture) can enhance technology-based learning experience. As depicted in Figure 1, the TLE framework offers a novel perspective on understanding the interaction between Media and Method in the educational technology field, introducing eight additional dimensions to consider.

Therefore, TLE can be utilized as a communication tool in instructional design and research teams to promote a thorough understanding and implementation of these diverse elements, ensuring a cohesive and effective instructional design approach.

References

Adorno, F. P. (2018). Rethinking human enhancement: Social enhancement and emergent technologies. *Nanoethics 12*, 247–250. https://doi.org/10.1007/s11569-018-0328-7

Akbiyik, A. (2012). *A study on determining the factors affecting the use of social software in distance education* (Publication No. 319845) [Doctoral dissertation, Sakarya University]. Council of Higher Education, Thesis Center.

Akpinar, E. (2006). *Computer assisted instruction in constructing of abstract concepts in science teaching: The unit electricity in our life* (Publication No. 189845) [Doctoral dissertation, Dokuz Eylul University]. Council of Higher Education, Thesis Center.

Anohina, A. (2005). Analysis of the terminology used in the field of virtual learning. *Educational Technology & Society*, *8*(3), 91-102.

Asan, A. (1998). *Computer aided instruction in religious education* (Publication No. 72087) [Doctoral dissertation, Ondokuz Mayıs University]. Council of Higher Education, Thesis Center.

Association for Educational Communications and Technology (AECT). (2023). *The Definition and Terminology Committee*. https://aect.org/news_manager.php?page=17578

Basdogan, M., & Birdwell, T. (2024). How to design "cultivated spaces" in active learning classrooms: Analysis of faculty reflections on learning space. *Learning Environments Research*, 1-21. http://dx.doi.org/10.1007/s10984-024-09496-y

Basdogan, M., & Bonk, C. J. 2023. Navigating online learning through "technological frames": A qualitative examination. *Online Learning Journal*, *27*(4). https://doi.org/10.24059/olj.v27i4.4030

Biesta, G. (2010). Learner, student, speaker: Why it matters how we call those we teach. *Educational Philosophy and Theory*, *42*(5-6), 540-552. http://dx.doi.org/10.1111/j.1469-5812.2010.00684.x

Bond, M., Zawacki-Richter, O., & Nichols, M. (2019). Revisiting five decades of educational technology research: A content and authorship analysis of the British Journal of Educational Technology. *British Journal of Educational Technology*, *50*(1), 12-63. http://dx.doi.org/10.1111/bjet.12730

Bozkurt, A., Keskin, N. O., & De Waard, I. (2016). Research trends in massive open online course (MOOC) theses and dissertations: Surfing the tsunami wave. *Open Praxis*, *8*(3), 203-221. http://dx.doi.org/10.5944/openpraxis.8.3.287

Castañeda, L., & Selwyn, N. (2018). More than tools? Making sense of the ongoing digitizations of higher education. *International Journal of Educational Technology in Higher Education*, *15*(1), 1-10. http://dx.doi.org/10.1186/s41239-018-0109-y

Celik, D. (2017). *Assessment of the practices of distance education centers in universities of Turkey in terms of adult education* (Publication No. 468268) [Doctoral dissertation, Ankara University]. Council of Higher Education, Thesis Center.

Clark, R. E. (1994). Media will never influence learning. *Educational Technology Research and Development, 42* (2), 21-29. https://doi.org/10.1007/BF02299088

Cole, W. D. (1987). Terminology: Principles and methods. *Computers and Translation*, *2*(2/3), 77-87. http://dx.doi.org/10.1007/BF02274438

Cone, J. D., & Foster, S. L. (1993). *Dissertations and theses from start to finish: Psychology and related fields*. American Psychological Association.

Dağhan, G., & Gündüz, A. Y. (2022). Research trends in educational technology journals between 2000 and 2018: A web scraping study. *Education and Information Technologies*, 1-36. http://dx.doi.org/10.1007/s10639-021-10762-2

Deleuze, G. (1994). *Difference and repetition.* Columbia University Press.

Deleuze, G., & Guattari, F. (1994). *What is philosophy?* (translated by G. Burchell & H. Tomlinson). Verso.

Denzin, N. K., & Lincoln, Y. S. (Eds.) (2011). *The SAGE handbook of qualitative research* (5th Ed.). SAGE Publications

Drexhage, J., & Murphy, D. (2010). *Sustainable development: From Brundtland to Rio 2012, Background paper for the high-level panel on global sustainability*. United Nations.

Fairclough, N. (2013). *Critical discourse analysis*. [VitalSource Bookshelf]. https://bookshelf.vitalsource.com/#/books/9781317864646/

Falck, R. S., Davis, J. C., Li, L., Stamatakis, E., & Liu-Ambrose, T. (2022). Preventing the "24-hour Babel": The need for a consensus on a consistent terminology scheme for physical activity, sedentary behaviour and sleep. *British Journal of Sports Medicine, 56*(7), 367-368. http://dx.doi.org/10.1136/bjsports-2021-104487

Foks, J. (1987). Towards open learning. In P. Smith & M. Kelly (Eds.), *Distance education and the mainstream* (pp. 74–92). Croom Helm.

Hancer, A. H. (2005). *An investigation of the effects of computer aided instruction in a constructivist learning environment on learning outcomes in science education* (Publication No. 159336) [Doctoral dissertation, Gazi University]. Council of Higher Education, Thesis Center.

Hew, K. F., Lan, M., Tang, Y., Jia, C., & Lo, C. K. (2019). Where is the "theory" within the field of educational technology research? *British Journal of Educational Technology, 50*(3), 956-971. http://dx.doi.org/10.1111/bjet.12770

Ihde, D. (2009). *Postphenomenology and technoscience: The Peking University lectures*. Suny Press.

Ilic, U. (2018). *Effect of disfluency on learning outcomes, metacognitive judgements and cognitive load in computer assisted learning environments* (Publication No. 523599) [Doctoral dissertation, Anadolu University]. Council of Higher Education, Thesis Center.

Irmak, E. (2007). *Implementation of the internet-based laboratory for distance education* (Publication No. 201135) [Doctoral dissertation, Gazi University]. Council of Higher Education, Thesis Center.

Kantaglu, B. (2012). *Student satisfaction measurement in e-learning* (Publication No. 313131) [Doctoral dissertation, Sakarya University]. Council of Higher Education, Thesis Center.

Karaaslan, I. A. (2008). *The effective Web design model in distance learning and an application* (Publication No. 215748) [Doctoral dissertation, Dokuz Eylul University]. Council of Higher Education, Thesis Center.

Kocdar, S. (2011). *Accreditation of distance education programs in Turkey based on expert opinions* (Publication No. 296585) [Doctoral dissertation, Anadolu University]. Council of Higher Education, Thesis Center.

Kozma, R. B. (1994). Will media influence learning? Reframing the debate. *Educational Technology Research and Development, 42*(2), 17-19. https://doi.org/10.1007/BF02299087

Kuhn, T. S. (1962). *The structure of scientific revolutions*. University of Chicago Press.

Kumar, M., & Noble, C. H. (2016). Beyond form and function: Why do consumers value product design? *Journal of Business Research, 69*(2), 613-620. http://dx.doi.org/10.1016/j.jbusres.2015.05.017

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. John Wiley & Sons.

Moore, J. L., Dickson-Deane, C., & Galyen, K. (2011). e-Learning, online learning, and distance learning environments: Are they the same? *The Internet and Higher Education, 14*(2), 129-135. http://dx.doi.org/10.1016/j.iheduc.2010.10.001

Oxford English Dictionary. (2023). https://www.oed.com/dictionary/sustainability_n?tl=true

Ozer, B. (1989). *The effectiveness of the two-year diploma program for elementary school teachers through distance education in including the knowledge of educational theory and practice* (Publication No. 8853) [Doctoral dissertation, Anadolu University]. Council of Higher Education, Thesis Center.

Ozkan, M. (2016). *Motivating and engaging EFL learners in e-learning with game elements* (Publication No. 441375) [Doctoral dissertation, Cukurova University]. Council of Higher Education, Thesis Center.

Pilli, O. (2008). *The effects of computer-assisted instruction on the achievement, attitudes and retention of mathematics in 4th grade courses* (Publication No. 227694) [Doctoral dissertation, Middle East Technical University University]. Council of Higher Education, Thesis Center.

Reid, G. W. (2007). *From concept to form in landscape design.* John Wiley & Sons.

Simonson, M. (1995). Does anyone really want to learn at a distance? *TechTrends, 40*(5), 12. http://dx.doi.org/10.1007/BF02818825

Stepanyan, K., Littlejohn, A., & Margaryan, A. (2013). Sustainable e-learning: Toward a coherent body of knowledge. *Educational Technology & Society, 16*(2), 91-102.

Sterling, S. (2014). Education in change. In S. Sterling & J. Hunkle (Eds.), *Education for sustainability* (pp. 18-39). Routledge. https://doi.org/10.4324/9781315070650

Sulukcu, Y. (2011). *Developing computer assisted materials in teaching Turkish to foreigners (Basic User A1) and its effects on students' success* (Publication No. 280649) [Doctoral dissertation, Selcuk University]. Council of Higher Education, Thesis Center.

Tavakoli, M., Carriere, J., & Torabi, A. (2020). Robotics, smart wearable technologies, and autonomous intelligent systems for healthcare during the COVID-19 pandemic: An analysis of the state of the art and future vision. *Advanced Intelligent Systems*, *2*(7), 2000071. https://doi.org/10.1002/aisy.202000071

Turhan, E. (2005). *Opinions of school administrators on managerial processes and distance education technologies-the province Eskişehir case* (Publication No. 187957) [Doctoral dissertation, Anadolu University]. Council of Higher Education, Thesis Center.

Turner, K., & Belesky, D. (2010). Terminology revisited: Effective communications for the agricultural community. *Journal of Extension*, *48*(2). http://dx.doi.org/10.34068/joe.48.02.05

Whittle, C., Tiwari, S., Yan, S., & Williams, J. (2020). Emergency remote teaching environment: A conceptual framework for responsive online teaching in crises. *Information and Learning Sciences*, *121*(5/6), 311-319. https://doi.org/10.1108/ILS-04-2020-0099

Appendix A. Digital dataset

https://docs.google.com/spreadsheets/d/1qtT9teBZeEoBaOl6qCxwNu5mRPKmESFD/edit#gid=763300640

Appendix B. Technology-based Learning Environment (TLE) framework

Main themes	Sub-themes
(1) Space *The area /location/ distance/ realm/ domain where teaching and learning activities take place.*	• Transcendence: Theoretical space such as learning model, education system, and teaching approach. • Immanence: Action-based space such as the use of computers, and educational activities. • Actual: A reference to the concrete existence of the space informed by the use of specific words such as tools, setting, location, and environment. • Virtual: A space character that does not physically exist such as innovative, flexible, sustainable, and efficient. • N/A: Non mention to space.
(2) Time *The period or moments in which the recurring instances or actions happen.*	• Linear: Synchronous and sequential. • Nonlinear: Asynchronous and free of time barriers. • Repetitive: Reinforcement-related moments. • Process: Specific time interval. • N/A: No mention to time.
(3) Agent *Definition: The actors in the learning environment*	• Human: Individuals or groups. • Posthuman: Entities beyond the human body such as technological and educational processes, interfaces, and information systems.
(4) Level of Operations *Definition: The scale of the learning and teaching activities.*	• Macro • Meso • Micro
(5) Rules *Definition: The form and structure of the learning and teaching environment*	• Intentionality, Reciprocity, Personalization, Free, and Structured. Semi-structured, Non-structured, and Institution-based.
(6) Power *Definition: Socially constructed roles of human actors.*	• Hierarchy: Existence of a ranking between the roles of the human actors. Heterarchy: Unranked and flexible relationships without any uppermost human actors.
(7) Culture *Definition: Social dynamics, principles, and norms of the learning and teaching environment.*	• Singularity, Multiplicity, Connectivity, Motivation, Inclusion, Accessibility, Openness, Flexibility, Authenticity, Active learning, and Lifelong learning.
(8) Research Approaches *Definition: Educational technology scholars' research agenda over the years.*	• Year of publication. • Research paradigms. • Research topics.