Mapping the Landscape of Doctoral Research in Technologies in Education: A 25-Year Analysis in Portuguese Universities

Fernando Albuquerque Costa *[ID] and Elisabete Cruz [ID]

Instituto de Educação, Universidade de Lisboa, 1649–013 Lisbon, Portugal; ecruz@ie.ulisboa.pt
* Correspondence: fc@ie.ulisboa.pt

Abstract: In the context of the evolving landscape of doctoral education within the framework of a knowledge society, this study explores the landscape of doctoral research in the field of technologies in education (TE) within Portuguese universities. The investigation places its focus on understanding the composition and evolution of research themes over 25 years (1997–2022), unveiling the landscape's responsiveness to the challenges of a technologically advanced society. Employing a scientometric approach, we analyse 380 doctoral dissertations, highlighting the authors' nationalities and genders, as well as the burgeoning themes, research questions, and methodological frameworks. Our results reveal a diverse range of themes, with "Teaching and Learning" and "Professional Development" emerging as predominant areas of exploration. Researchers predominantly derive their problems from real educational contexts, seeking to enhance understanding and intervention. This study underscores a shift from a technology-centric perspective to one focused on pedagogical considerations. Through this article's objective representation, our findings highlight the multifaceted nature of TE research in Portuguese universities and its implications for innovation and knowledge advancement in education.

Keywords: technologies in education; digital technologies; doctoral research; doctoral dissertations; research trends; Portugal

1. Introduction

In the context of the ongoing societal shift towards a knowledge-driven paradigm, universities are undergoing a profound transformation in their approach to advanced doctoral education. This transformation has become particularly pronounced in the 21st century, and has led to a departure from the conventional model of doctoral education, which primarily revolves around the student–supervisor relationship. Instead, it has given rise to a strategic perspective on doctoral education, recognising it as an essential resource for addressing the multifaceted challenges presented by our technologically advanced society [1].

Building upon this perspective, and acknowledging the pivotal role of post-graduate studies in advancing knowledge and its practical applications across diverse domains [2], it becomes imperative to gain insight into the nature of doctoral research. This understanding is vital in assessing its contribution to fostering innovation and knowledge generation, especially in light of the profound impact of digital technologies across various sectors and institutions in society [3–5].

Our study is positioned within this context, focusing on doctoral research conducted within Portuguese universities, specifically within the area of education, with a narrower emphasis on technologies in education (TE). Over the past three decades, TE has experienced rapid growth, prompting significant efforts to integrate digital information and communication technologies into educational and training contexts [6].

TE, drawing on a diverse range of disciplinary sources that have evolved in response to technological advances, notably marked by the advent of personal computers [7], has

emerged as a prominent research domain. It seeks to comprehensively explore the potential of digital technologies, aiming to enhance the entire educational process, as well as students' learning experiences and outcomes [6,8,9].

While certain technologies are still in the process of establishing their presence in educational research [10,11], TE has evolved into a significant sub-field within the broader domain of education [8]. A deeper exploration of this sub-field is essential for understanding its subject matter and the prevailing directions in scientific inquiry [5,7]. Research trend analysis is of particular significance. It not only aids in identifying and documenting shifts over time but also guides future research directions, which is particularly valuable for emerging researchers. This guidance helps to avoid redundancy and encourages the exploration of emerging areas [12–14], innovative methodologies [15], and alternative approaches to presenting research findings [16].

In summary, the study proposed here is justified, first and foremost, by the lack of an existing comprehensive and in-depth analysis specifically focused on doctoral dissertations in the field of TE. It offers a unique opportunity to consolidate and critically evaluate the existing knowledge base within the context of doctoral research in Portugal. Secondly, due to the rapidly evolving nature of TE, with new trends, tools, and technologies constantly emerging, this study provides an updated overview of the doctoral research conducted in this country. This updated perspective is crucial for informing future educational practices. Indeed, understanding the current landscape of doctoral dissertations in TE can have significant implications not only for pedagogical practices but also for educational policies. Through the identification of gaps or trends, the results can guide decision-makers in the education sector and, particularly, at universities, in conducting doctoral studies. Lastly, by examining the specific context of Portugal, this study may uncover unique challenges, solutions, or insights that are not well represented in the existing literature, thus enriching the global discourse on TE research.

Given the breadth of this study, we adopt the definition of TE proposed by Canan et al., who define it as "as a complex and integrated systems process containing method, technique, and assistance to realise the learning-teaching functions in a quality way, putting into practice various methods, tools, and materials to enable individuals to learn at the highest level and seeking answers to the questions of "what" and "how should we teach" in the process of designing and learning-teaching environments" [17] (p. 287).

From this standpoint, TE constitutes a field of study dedicated to investigating how instructional and learning processes can harness the capabilities of technology at various stages. Initially, this involves extending or substituting traditional teaching methods with digital tools. Subsequently, the focus shifts towards leveraging technology to promote student autonomy in constructing knowledge [18–21]. Additionally, TE encompasses educational resource development, the design and management of physical and virtual learning spaces, and the preparation of educators [22].

The evolution of TE has been influenced by contributions from various disciplines related to education, such as psychology, communication, management, and pedagogy, adapting to the emergence of new technologies over time [23]. These technologies range from analogue materials to personal computers, multimedia resources, digital networks, and artificial intelligence, including mass media like radio, cinema, and television. While analogue tools remain relevant, the prevalence of computers and digital technologies has surged, garnering increased attention from researchers [24].

The 21st century, characterised by widespread internet access, rapid technological advancements, and new opportunities for schools and educators, has ushered in new research possibilities. These encompass the design, development, intervention, and evaluation of diverse pedagogical experiences and their impact on student performance [25,26]. Notably, there has been a significant surge in the study of technology integration for educational purposes, as evidenced by a threefold increase in TE publications between 2011 and 2018 [6].

The state of the art. In the current century, driven prominently by widespread Internet access and swift technological advancements in the digital realm, along with the novel

possibilities bestowed upon educational institutions and educators, fresh realms of investigation and prospective vistas have unfolded for researchers. These realms encompass not only the conception and advancement of pedagogical strategies but also the execution and assessment of distinct educational experiences, gauging their influence on student achievements [5,25]. Additionally, there has been a substantial upsurge in the scrutiny of matters linked to the integration of technologies for educational pursuits. As noted by Dubé and Wen, this growth is evidenced by a substantial escalation in the number of TE-related publications between 2011 and 2018, a surge of approximately 300% across this timeframe [6].

Regarding the evolution of research themes and topics, there has been a growing inclination towards studies that scrutinise the educational potential of digital technologies in the context of online education and training. As pointed out by An, this inclination envelops not only purely online approaches but also hybrid methodologies [25]. Furthermore, inquiries have extended to encompass the formulation of online learning resources, along with the establishment, administration, and assessment of systems that facilitate interpersonal communication among students and between students and teachers. An's observations highlight that, in the 21st century, the research focus has been notably shifting towards areas such as social networks, mobile devices, the cultivation and progression of learning communities, and the exploration of informal learning pathways enabled by web access. This also encompasses the exploration of initiatives like open educational resources (OERs), mass open online courses (MOOCs), virtual reality (VR), augmented reality (AR), gamification, and digital game-based learning.

Following a similar trajectory, this pattern is discernible in the pioneering work of Martin et al., who based their insights on the Horizon reports detailing influential technologies in school settings spanning from 2004 to 2010 [26], as well as the investigations conducted by Dubé and Wen, which encompassed the period from 2011 to 2017 [6]. In the former study, the researchers identified seven clusters in order of impact, ranging from the social web to augmented reality. The intervening categories encompassed mobile devices, games, the semantic web, man–computer interaction, and learning objects. The latter study by Dubé and Wen employed a parallel methodology and highlighted six trends, again in order of impact: mobile devices, games, learning analytics, simulation technologies, maker technologies, and artificial intelligence [6]. When comparing these two studies, the authors underscore the sustained prominence of mobile technologies and games, alongside the emergence of learning analytics and artificial intelligence [6].

Furthermore, the recent scholarly curiosity towards emergent technologies like artificial intelligence, virtual reality, and augmented reality is underscored by Kimmons et al. In their scrutiny of a corpus exceeding two thousand articles from scientific journals within the field of TE, published in 2021, these terms recurrently surfaced within the scientific literature [27]. By examining keyword frequencies in these studies, encompassing phrases comprised of two words, the authors elucidate that computational thinking and learning environments stand as the most frequently referenced subjects.

Although less numerous, the examinations of doctoral dissertations within the TE domain conducted in various countries can serve as pertinent sources of information. These analyses aid in recognising and tracking the evolution of research interests and topics across diverse geographical and academic settings, alluding to consistent trends that align with those outlined here [28].

This phenomenon is evident, as exemplified by the research conducted by Durak et al., who aimed to scrutinise dissertations completed in the domain of TE in Turkey up to 2018 [29]. Through their investigation, encompassing a total of 137 theses, including master's dissertations, they discovered that online learning holds the foremost position as the most prevalent subject. This is closely followed by the broader domain of information and communication technologies, teacher training, and special education. With regard to areas of specialisation, the same study elucidates a marked prevalence of dissertations focused on education and training (80.6%), in contrast to fields associated with sciences and technology

or computing sciences, which were notably less represented. Theoretical underpinnings were also explored, with nearly half of the scrutinised dissertations anchored in at least one theoretical framework. The most cited theoretical foundations encompass multimedia learning theories, constructivist theories, and notably, the technology acceptance model (TAM). The authors highlight that many of these dissertations did not cite any theories or specific theoretical framework [29].

In a separate study conducted in Turkey, Kara and Can examined 705 theses, concluding that the most prevalent research focus was on learning environments. This theme constituted the subject of inquiry in roughly one third of the examined theses. However, an observed decline in recent years is noted within the analysed time frame (1996–2016) [30]. A parallel diminishing trend is also discernible in topics related to pedagogy, learning/instruction/teaching theory, and assessment. Conversely, subjects like emerging technologies and the acceptance thereof, as well as teacher/trainer and learning themes, demonstrated an upward trajectory. This trend was particularly prominent in the latter years of the analysed period [30].

Also in Turkey, an inquiry into the trajectory of subject matters in 292 doctoral dissertations completed from 2011 to 2020 was undertaken by Gunduz et al. In their results, notably, they underscore an amplified interest in educational/3D games, particularly evident within the timeframe of 2015–2020 [7]. The researchers attribute this inclination mainly to the advancement of graphical technology. Consequently, the exploration of the ramifications of employing virtual reality within educational settings, especially regarding its entertainment aspect, becomes a central focus. The investigation specifically hones in on the potential of these strategies to kindle students' motivation for learning [7].

Conducted in Pakistan, another investigation undertaken by Asdaque and Rizvi aimed to depict the landscape of research concerning online education within the context of Allama Iqbal Open University's doctoral program. This study spanned the period between 2001 and 2014 and was based on an examination of 37 theses. Their findings highlighted that the most prevalent subjects were centred around course design (instructional design), student support services, student characteristics, and the professional development of teaching staff [31]. However, the authors bring to light an inherent asymmetry in the topics under exploration. They argue that a collection of crucial research domains related to online education do not attract comparable attention from Ph.D. scholars. Specifically, they emphasise aspects concerning quality assurance, management, and the evolution of research methodologies within online education as areas warranting increased investigation [31].

In the context of Portugal, a meta-analysis conducted by Coutinho and Gomes pertained to research within the Master's Program in Educational Technology at the University of Minho. This examination encompassed 60 master's dissertations finalised between 1995 and 2005. The analysis revealed that the predominant research subjects revolved around resources, methodologies, strategies, and pedagogical techniques facilitated by information and communication technology systems. These encompassed domains like hypermedia, audiovisual/video materials, multimedia and educational software, imagery, the Internet and the World Wide Web, and e-learning and online education, as well as virtual learning environments [32].

The examination of technologies emerges as a primary focus within the study, as demonstrated in the analysis of 226 master's theses finalised between 1986 and 2005. This inquiry, conducted by Costa, underscores the prominence of technologies as both subjects of scrutiny (for instance, evaluating educational software) and objects of development. In this regard, studies centred on the creation and enhancement of innovative pedagogical and didactic resources come to the fore [33]. Costa's analysis further notes the emergence of subjects within the pedagogical domain that are more directly interwoven with the integration of digital technologies. This includes their application in teacher training, as well as within educational institutions and the broader teaching and learning milieu [33].

In our examination of the literature review as a whole, the pursuit of comprehending this phenomenon surfaces as a central aspect. It becomes evident that this phenomenon

is markedly intricate and wide-ranging, surpassing the narrower technological focus. Although a substantial portion of the studies aimed to assess or validate the viability of the prevailing technology as a method or solution for addressing historical issues associated with traditional school-based learning built around a prescriptive curriculum [34], this evolving trajectory prompts a reconsideration of the objectives and intentions of the research within this domain. This shift amplifies the longstanding belief that it is necessary to highlight how technologies become integrated within diverse educational contexts. This shift, furthermore, fosters an inclination towards embracing the influence of other knowledge domains, and thereby fostering interdisciplinary perspectives. This inclination prompts those in related fields of study to investigate topics traditionally confined to researchers with technology backgrounds [35,36].

Research questions. Taking into consideration these reflections, and over the three decades since the introduction of digital technologies in Portuguese education and the first TE-specific Ph.Ds. [15], our study endeavours to initiate a series of projects aimed at identifying, mapping, and scrutinising the scientific research conducted within Portuguese universities. With a specific focus on the doctoral level, this paper delves into three core dimensions of analysis for characterising doctoral research within the domain of TE at Portuguese universities. These dimensions encompass Authors and Dissertations, Issues Studied, and University Contexts. Each dimension is explored through a set of interconnected research questions, shedding light on the authors, themes, topics, technologies, and contextual aspects of these dissertations, as described below:

- Authors and Dissertations: RQ1.1. What is the nationality of the authors of the dissertations? RQ1.2. What is the gender of the authors? RQ1.3. How has the number of dissertations evolved over a span of 25 years (1997–2022)?
- Issues Studied: RQ2.1. What are the predominant themes addressed within the dissertations? RQ2.2. Which specific topics emerge under these themes? RQ2.3. What drives the selection of research problems? RQ2.4. What is the main purpose of the studies carried out? RQ2.5. Which educational technologies and tools are the primary subjects of investigation? RQ2.6. What theoretical frameworks serve as the foundation for the studies?
- University Contexts: RQ3.1. Which institutions provide the academic settings for the investigated dissertations? RQ3.2. Which specific Ph.D. courses and specialties do these dissertations align with? RQ3.3. Which supervision models are most commonly used in the research process?

Through this inquiry, we strive to provide a comprehensive understanding of the landscape of doctoral research within the realm of TE in Portuguese universities. By addressing these dimensions, our study contributes to the advancement of scholarship by offering a nuanced perspective on the evolving intersections between technology, education, and research. This investigation not only enriches academic discourse but also provides valuable insights for educational practitioners, policymakers, and stakeholders seeking to harness the potential of technology to enhance learning outcomes and shape the future of education.

Therefore, before presenting the results in detail, we describe the methodology and procedures adopted to collect and analyse the empirical data supporting this study.

2. Methodology

2.1. Method

The study presented here use procedures typical of a scientometric analysis, with a view to identifying the trends in, and evolution of, the academic and scientific works carried out in Portugal in the field of TE. While some methods of literature review (e.g., critical review, integrative review, review of the state of the art, umbrella review) tend to summarise the results of the research, a scientometric analysis enables one to identify, as stated by Rashid et al., "research trends, publication and citation structures, authorship and collaboration patterns, bibliographic coupling, and productivity patterns" [37] (p. 1).

Andriamamonjy et al. define a scientometric analysis as "a quantitative approach that relies on large-scale bibliographical data to assess the development of the research domain through different qualitative indexes" [38] (p. 515). In this study, the bibliographical data are restricted to doctoral dissertations in the scientific area of education sciences/education that focus on specialities linked to the field of TE and were completed and defended in Portuguese higher education institutions.

2.2. Database Selection

Given that the object of research is doctoral dissertations carried out in Portugal, we made use of the National Registry of Theses and Dissertations (RENATES). This platform, created by Law no. 52/2002 of 2 March, and amended by Decree no. 285/2015 of 15 September, is an official information system of the Directorate-General of Education and Science Statistics, the purpose of which, among other functions, is to collect and preserve descriptive data about the work undertaken to obtain a Ph.D. The platform allows doctoral dissertations dated from 1970 onwards to be consulted, making it an important, comprehensive, and up-to-date source of information for the purposes of our research. Additionally, further research was carried out in the institutional repositories of all the universities identified previously.

2.3. Identification of Records

The identification, screening, and selection process of the *corpus* of analysis to carry out this study was inspired by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) system [39] (see Figure 1).
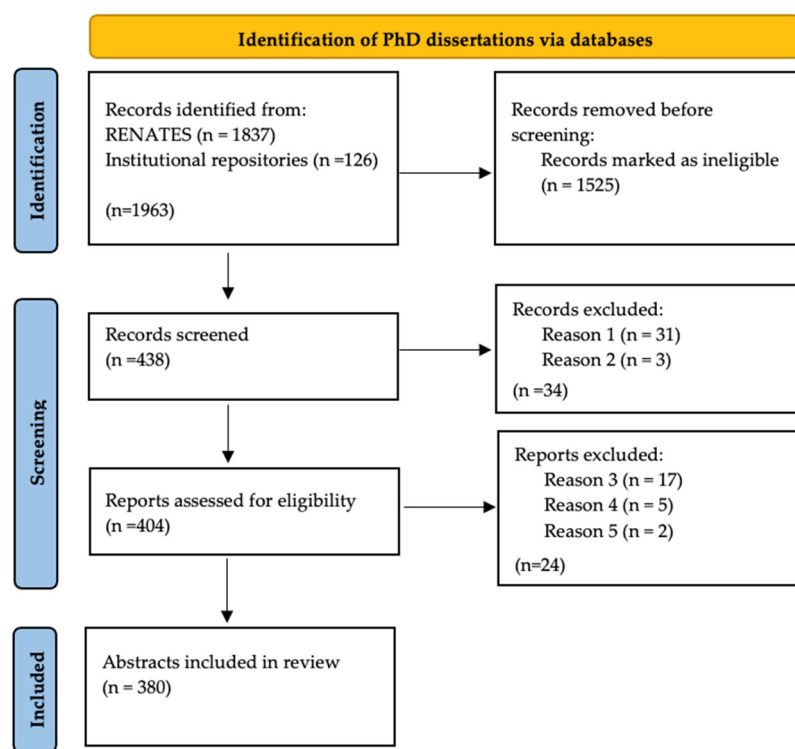

Reason 1. Abstract inaccessible or with little information about the characteristics of the study
Reason 2. Date of obtaining the doctor's degree after 2022
Reason 3. The abstract presents a study that does not fit in this review
Reason 4. The abstract does not contain information about the empirical component of the study carried out
Reason 5. The research does not include primary data collected in an educational context

Figure 1. Flow chart of the *corpus* selection process. Source: adapted from Page et al. [39].

After exploratory testing of the research functionalities available on the RENATES platform (https://renates2.dgeec.mec.pt/ accessed on 24 March 2023), we defined and

systematically applied the following research combination: Academic degree [PhDs in Portugal] + Establishment [selection of an institution from the indicated list] + Disciplinary area [education] + Status of the work [completed]. It was necessary to repeat this procedure for all universities that, in Portugal, offer doctoral courses in the disciplinary area of education. When the number of records surpassed the maximum limit that the platform returns (n = 200), as happened with the University of Minho (UM) and the University of Porto (UP), other variables had to be specified, taking advantage of the Additional Filters. In the first case (UM), as shown in Figure 2, the decision was made to restrict the identification of the doctoral dissertations to the field of "Educational Technology" (69 records) and "Child Studies" (195 records).
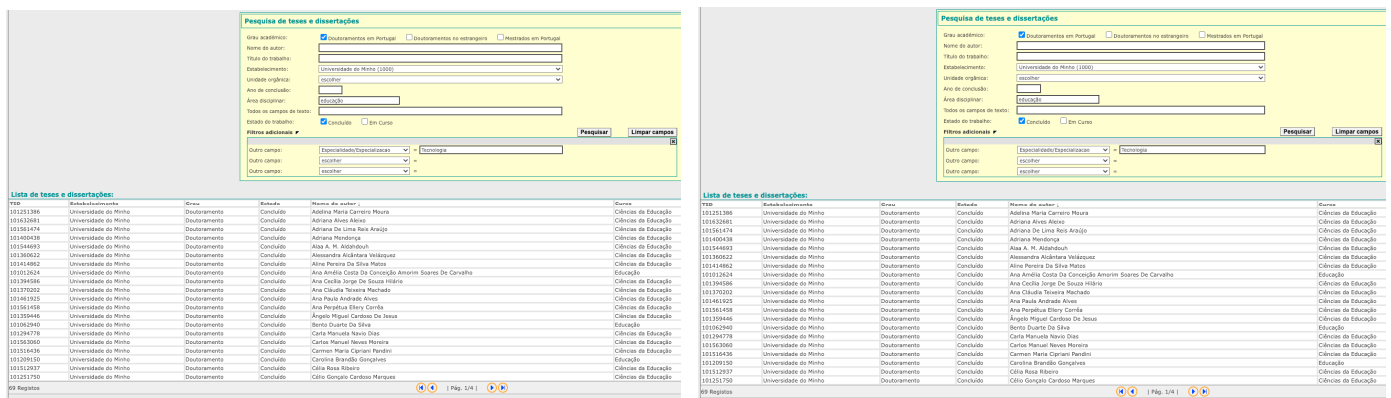


(a)   (b)

Figure 2. Research using the RENATES platform (UM): (**a**) the identification of doctoral dissertation records in education in the field of "Educational Technology" (69 records); (**b**) the identification of records of doctoral dissertation records in "Child Studies" (195 records).

In the case of the UP, as shown in Figure 3, the option was taken to carry out separate research in the three organic units with registries of doctoral dissertations in the area of education, namely in the Faculty of Psychology and Education Sciences (200 records), in the Faculty of Sciences (37 records), and in the Faculty of Letters (8 records).
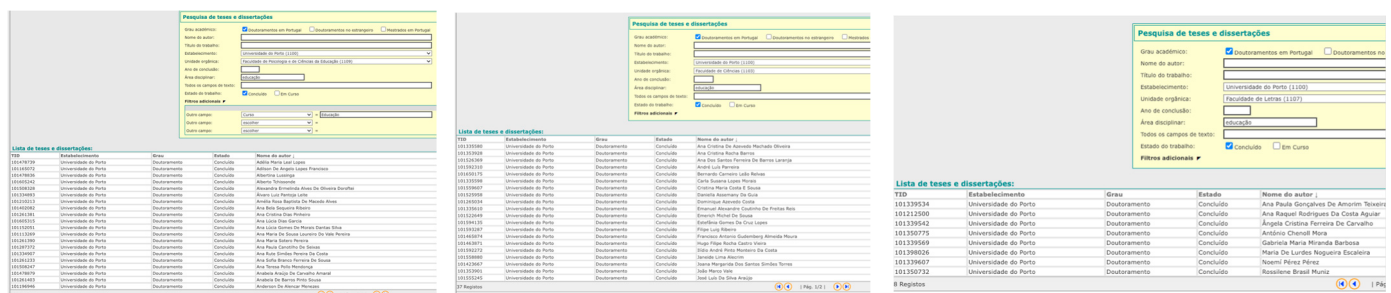
(a)   (b)   (c)

Figure 3. Research in the RENATES platform (UP): (**a**) the identification of records of doctoral dissertations in education carried out in the Faculty of Psychology and Education Sciences (200 records); (**b**) the identification of records of doctoral dissertations carried out in the Faculty of Sciences (n = 37 records); (**c**) the identification of records of doctoral dissertations carried out in the Faculty of Letters (n = 8 records).

The initial search on the RENATES platform, as shown in Figure 1, led to the identification of 1837 records, to which a further 126 were added from the additional research carried out by the investigators in the institutional repositories. Hence, a total of 1963 records were organised into different Excel files, containing all the information relative to the

variables that the system collects regarding each dissertation (the name and description of the variables are available online at: https://renates.dgeec.mec.pt/ws/renatesws.asmx accessed on 24 March 2023).

To identify the doctoral dissertations that explicitly addressed the use of technologies in an educational context, the next step involved refining the previously screened records (n = 1963). This entailed selecting all the dissertations carried out within the scope of the Multimedia course in Education, as well as those falling within the following specialties: Educational Communication, Communication in Education, Distance Education and E-Learning, Educational Technology, Educational Technology and Curricular Development, Information and Communication Technologies, Information and Communication Technologies in Education, Educational and Communication Technologies, and Technologies, Networks and Multimedia in Education and Training. Additionally, all dissertation titles that did not fall within these specialties were carefully analysed, and we opted to select the theses that demonstrated some relationship with the use of technology in an educational context. At the end of this process, 1525 records were eliminated, with 438 moving forward to the next phase (see Figure 1).

2.4. Screening of the Records

The screening phase began with the compilation of a consolidated database, opting to keep some of the variables constant in the record files of the dissertations extracted from the RENATES platform, namely: (i) author's name, (ii) gender, (iii) nationality, (iv) date degree obtained, (v) establishment, (vi) supervisors, (vii) course, (viii) speciality, (ix) title of the work, (x) URL, and (xi) keywords. Other variables were added, namely one field for the inclusion of the abstract of the dissertations previously recorded and another field for observations. After checking the information gathered during this phase, a total of 34 records were initially excluded: 31 records because the abstract was not accessible or did not contain enough information about the characteristics of the study (reason 1), and 3 records because the date the Ph.D. was obtained was after 2022 (reason 2). In a second step, based on reading the abstracts, 24 records were excluded for the following reasons: reason 3—the abstract presented a study that did not fit this review (17 records); reason 4—the abstract did not contain information about the empirical component of the study carried out; and reason 5—the research did not include primary data collected in an educational context (2 records).

To summarise, the final *corpus* meticulously selected for analysis consisted of 380 abstracts of doctoral dissertations on education, focusing on the field of TE, carried out in Portuguese higher education institutions.

2.5. Coding Process

Upon completing the previous phase, a critical reading of the *corpus* that had been compiled took place, with all the abstracts organised according to their university. Focusing on reading the abstracts of the dissertations, but always consulting the documents themselves available in the repositories when necessary, the goal was to identify the items that would allow a detailed description of each research project. This description was drawn up through a coding process based on a set of categories and describers derived from the aforementioned research questions, with necessary adjustments resulting from the emergence of some describers not initially planned.

In practice, this task involved the prior definition of the system of categories shown in Table 1, attempting to precisely establish the significance of the different subcategories (or codes) for systematic use in the analysis and coding of the data. To make sure the process was reliable, the two authors of the study were involved in the various steps of the coding process and the respective analysis, first separately and then together, with the aim of solving doubts derived from reading the merged data.

Table 1. Our system for analysing and coding Ph.D. theses.

Research Questions	Categories	Codes
RQ1.1; RQ1.2; RQ1.3	Gender	M; F
	Nationality	PT; BR; M; A; CV; Other
	Dissertation date	<2000; 2000–2005; 2006–2010; 2011–2015; 2016–2022
RQ2.1; RQ2.2; RQ2.3; RQ2.4; RQ2.5; RQ2.6	Main theme	1. AudioVisual; 2. TeachingLearning; 3. TeacherTraining; 4. SpecialEducation; 5. DigitalTechniques; 6. Other; 0.NR
	Specific topics	Topics (open coding)
	Origin of the problem	1.InvLines; 2. Real; 3. Other; 0.NR
	Main purpose	1. AnalysisDescription; 2. Development; 3. Interv; 4. Other; 0.NR
	Technologies	Educational technologies and tools (open coding)
	Theoretical frameworks	1. Behavioural; 2. Communicational; 3. CognConstr; 4. Connectivity; 5. HipMulti; 6. ID; 7. Systemic; 8. Multi-reference; 9. Other; 0.NR
RQ3.1; RQ3.2; RQ3.3	Institution	Institutions (open coding)
	Course	Courses (open coding)
	Speciality area	Specialties (open coding)
	Supervisors	Names (open coding)
	Supervision model	1. Individual; 2. Co-Supervisors

2.6. Data Analysis

To analyse and process the data, we used a combination of qualitative and quantitative techniques, opting to use Microsoft Excel software. Hence, in addition to the interpretations made to highlight the main trends observed in the data, through triangulation between peers (the authors of this article), the results will be displayed with the aid of tables and other graphical representations that are deemed suitable to provide a more complete vision of the findings and, simultaneously, to ensure the transparency and reliability of the research carried out [40].

3. Results

The results presented here are organised to help answer the questions in the order they were asked. Therefore, firstly, the dissertation authors are described by gender and country of origin, and the date the dissertations were defended. Afterwards, the results referring to the different aspects are presented, with the aim of characterising the issues studied. Lastly, information is presented with regard to the distribution of the dissertations according to the university contexts where they were carried out, breaking down the formal framework of the Ph.D. courses and specialties, the number of supervisors involved, and the type of supervision adopted.

3.1. Authors and Dissertations

Given that the collection of data is limited to the information available in the databases consulted, it was only possible to obtain information about the nationality and gender of the Ph.D. students.

3.1.1. What Is the Nationality of the Authors of the Dissertations?

Although, as one would expect, Portugal is the country of origin of the majority of the dissertation authors (70.8%), as can be seen in Table 2, it is particularly striking that the number of international doctoral students who seek Portuguese universities to complete their Ph.Ds. (111) accounts for close to one third of the total (29.2%).

Table 2. Authors by nationality.

Nationality	N	%
Portugal	269	70.8
Brazil *	82	21.6
Mozambique *	11	2.9
Angola *	8	2.1
Cape Verde *	2	0.5
Others **	8	2.1
Total	380	100.0

Key: * PALOP (Portuguese-speaking country); ** Spain (1), Hungary (1), Netherlands (1), Costa Rica (1), Mexico (1), Uruguay (1), United Arab Emirates (1), Jordan (1).

Among this contingent of Ph.D. students, it can be seen that almost all of them come from the different Portuguese-speaking countries (PALOP), totalling 103, which is 27.1% of all the students.

### 3.1.2. What Is the Gender of the Authors?

The results in Table 3 show a prevalence of the female gender. Around two thirds of the dissertations are carried out by women (63.4%), with 36.6% conducted by men.

Table 3. Dissertations by the gender of the author.

Gender	N	%
Female	241	63.4
Male	139	36.6
Total	380	100.0

3.1.3. How Has the Number of Dissertations Evolved over a Span of 25 Years (1997–2022)?

In general, as can be seen in the graph illustrating the evolution of the number of dissertations per year (Figure 4), the scientific production in Ph.D. courses on TE over the last 25 years (1997–2022) reveals a non-linear upward trend, with some interruptions up to 2007. Up to the year 2010, the productivity was weak, and it is from that year onwards that we see a sharp rise in quantity, culminating in the highest number in the year 2018.
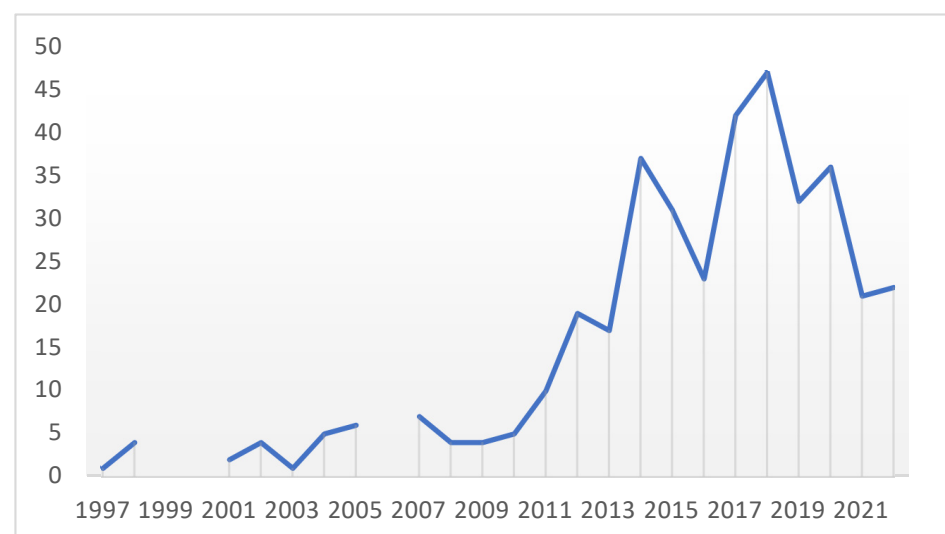
Figure 4. Evolution in the number of dissertations per year.

As in previous studies on research trends in the field of TE in Portugal [32], we organised the dissertations according to the date on which they were publicly defended,

considering the four 5-year periods of the 21st century, but also two other periods, to include the dissertations defended before the year 2000 and in the last two years, i.e., 2021 and 2022.

As such, and based on Table 4, one can see straight away that there is an overall upward trend in the quantity of dissertations up until the end of 2020. Starting with a low number of dissertations defended before the year 2000—just five theses (1.3%)—it is noticeable that a considerable rise took place in the first decade of the 21st century, with 38 dissertations defended, which corresponds to 10.0% of the total of the *corpus* analysed. On the other hand, an especially expressive jump occurs in the second decade of the 21st century, with the vast majority of the dissertations (290) completed in this period, also at an increasing rate over the two 5-year intervals (114 dissertations defended 2011–2015, with is equivalent to 30.0%, and 180 in 2016–2020, which is 47.4% of the total).

Table 4. Dissertations per period in which they were defended.

Period	N	%
Up to 2000	5	1.3
2001–2005	18	4.7
2006–2010	20	5.3
2011–2015	114	30.0
2016–2020	180	47.4
2021–2022	43	11.3
Total	380	100.0

3.2. Issues Studied

As mentioned above, to describe the issues studied, we used as a reference point a wide-ranging set of aspects to map the research undertaken, so as to enable a deeper understanding of what is being researched, why, and for whom. In practice, it is a question of mapping out a perspective of the research that is carried out for doctorates, to better understand its social relevance and its possible contribution towards innovation and change in teaching and learning methods in our schools. The following points refer specifically to each of the aspects included, i.e., to the main theme and the topics studied, the origin of the problems that give rise to the research, the main purpose as outlined by the authors of the dissertations, the technologies that are the object of attention and study and, finally, the scientific perspectives and theoretical assumptions taken as the reference points.

3.2.1. What Are the Predominant Themes Addressed within the Dissertations?

Based on Table 5, one can confirm a strong predominance of the study of themes related to the "Teaching and learning" process, in almost half of the dissertations (49.7%). In second place, 20% of the dissertations include themes in which the "Professional development" of the educational agents comprises the main focus of the researchers. That is, dissertations related to the formation and development of the skills needed to use technologies in education and training, both as regards their design and development, and in terms of their effective use in an educational or training context. Only afterwards do themes emerge that are directly related to the "Digital technologies" themselves, which account for 12.9%, i.e., the themes in which the technology itself (tools, resources, devices, etc.) are the object of interest of the researchers. In contrast, the "Audiovisual" category has the lowest frequency, featuring in only 10 dissertations carried out during the whole period under analysis, which is 2.6% of the total. The "Others" category, with 11.8%, included all the themes that did not fit into the other categories.

Table 5. Main themes.

Main Themes	N	%
Audiovisual	10	2.6
Teaching and learning	189	49.7
Professional development	76	20.0
Special education	11	2.9
Digital technologies	49	12.9
Others	45	11.8
Total	380	100.0

3.2.2. Which Specific Topics Emerge under These Themes?

With the aim of complementing these results and deepening our understanding of the specific topics studied, an analysis of an open nature was carried out on the content. This analysis involved reading and interpreting the content in the abstracts of the dissertations, in triangulation with the keywords mentioned by the authors themselves. This process gave rise to a total of 578 topics.

Looking at the 15 most frequently identified topics, which are shown in Figure 5, one can see that most of the dissertations focus mainly on pedagogical concerns related to the curricular integration of digital technologies (157 dissertations, 27.4%), followed by the study of the professional development of teachers (61 dissertations, 10.6%).
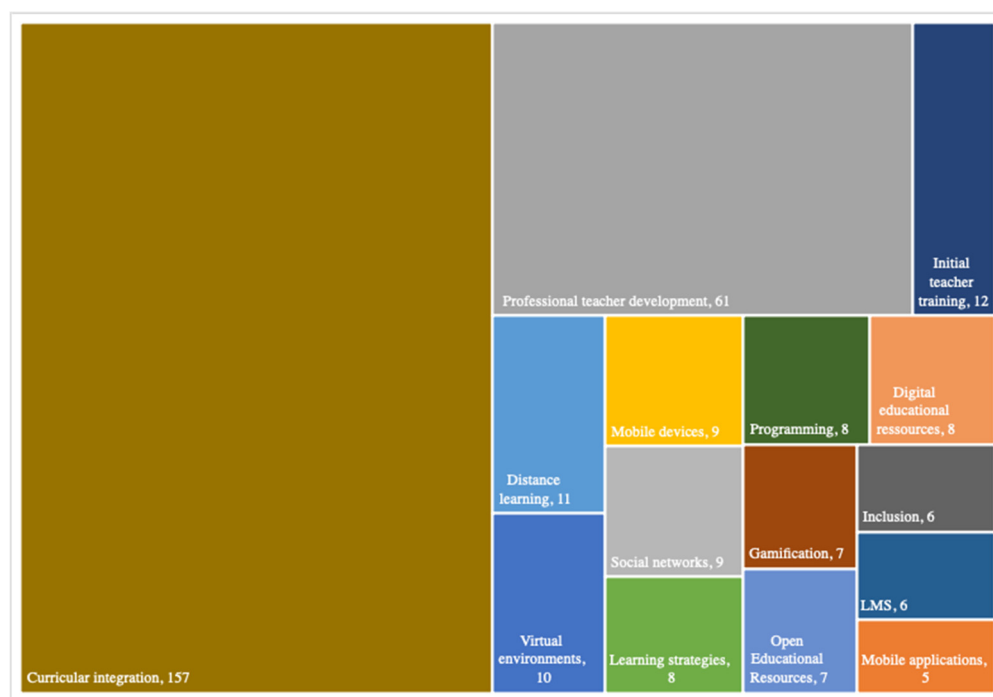
Figure 5. The most predominant topics (appearing in five or more dissertations).

Analysis of the other topics shown in the figure enables one to observe, on the other hand, that the focuses of the researchers covered a wide range of issues, each of which generated a relatively similar number of dissertations (5–11): online education (11 dissertations), virtual environments (10), mobile devices (9), social networks (9), programming (8), digital educational resources (8), learning strategies (8), open educational resources (7), LMS platforms (6), inclusion (6), and mobile applications (5). Overall, one can surmise that this set of topics is in line with the lower relevance of the technological aspect, as also observed in the previous point.

3.2.3. What Drives the Selection of Research Topics?

As for the origin of the topics studied, almost all the dissertations (93.9%) are based on identifying and systematising questions and/or problems that occur in the professional settings of the researchers themselves. As shown by the results presented in Table 6, the starting point for the studies analysed resides in the identification of "Real" educational or training problems. There are very few cases—only 10 in 380 (2.6%)—where it is stated that the problems studied are triggered by, and fall within, a certain pre-existing "Line of research" restricted to one centre or unit of investigation, in which the supervisors themselves carry out the scientific work. Finally, 13 dissertations (3.4%) did not contain sufficient information to determine the origin of the problems studied.

Table 6. Origin of the problems studied.

Problems	N	%
Lines of research	10	2.6
Real	357	93.9
Data missing	13	3.4
Total	380	100.0

3.2.4. What Is the Main Purpose of the Studies Carried Out?

As was to be expected, given that the research focused on practical professional matters, the collection and analysis of the data related to the underlying purpose behind the dissertations revealed the predominance of a stance aimed at understanding and describing educational phenomena. As can be concluded from the results presented in Table 7, the dominant purpose is "Analysis and description" (48.7%), closely followed by an orientation aimed at "Intervention" (32.4%).

Table 7. Main purpose.

Purpose	N	%
Analysis and description	185	48.7
Development	64	16.8
Intervention	123	32.4
Others	8	2.1
Total	380	100.0

It is also possible to observe a reasonable number of works that, again reinforcing the centrality of the production of knowledge contextualised and rooted in the real world, are carried out with a clear purpose of "Development" (16.8%), such as is the case of studies focused on the search for innovative solutions, reflecting, for example, on the design and development of digital educational resources and online learning spaces, environments, and communities. The "Others" category included all the dissertations that did not fit into the previously defined categories, totalling a residual number of just eight dissertations (2.1%).

3.2.5. Which Technologies and Tools Are the Primary Subjects of Investigation?

As with the procedures to find out which topics were the focus of study, we also mapped out the technologies and tools mentioned in the abstracts of the dissertations, mainly by applying open coding techniques. Respecting the terminology used by the authors, 138 different tools were identified, in 261 dissertations (i.e., 68.7% of the total). This first result, showing that approximately one third of the dissertations make no explicit reference to tools (31.3%), is another indicator that signals an inflection in the way that technologies are viewed in educational practices, reflected in the *corpus* under analysis by the concerns of a more pedagogical nature that are highlighted.

As can be seen in Figure 6, the "Web" is the tool that is most prevalent (present in 39 dissertations), followed by references to "Moodle" (25), "ICT" (22), "Web 2.0" (17), "Learning Management System" (14), "Mobile devices" (13), and "Facebook" (9). With a less expressive presence, accounting for only five or six dissertations, we find references to "Interactive board", "Social media", "Wiki", "Simulations", and "Smartphone".
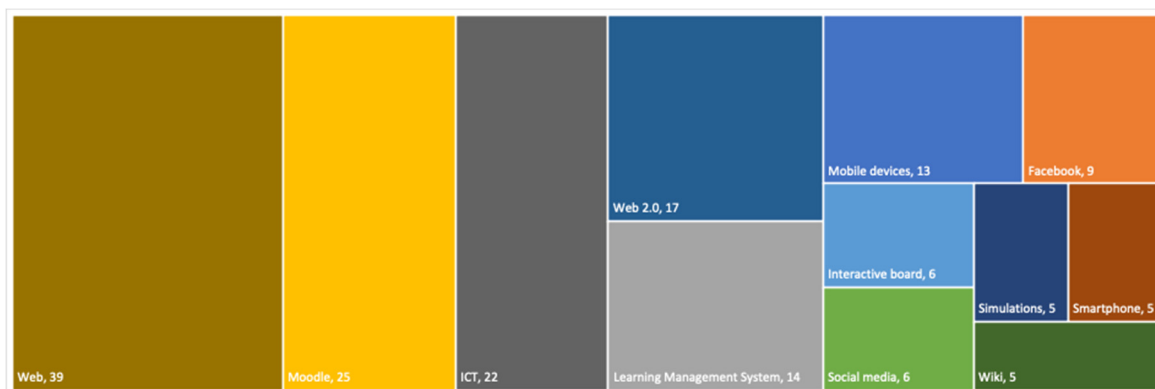

Figure 6. The most predominant tools (appearing in five or more dissertations).

Considering the variety of tools identified, in a second phase, an attempt was made to analyse possible trends with regard to the type of technologies mentioned in the dissertations, centring our attention on the educational functionalities or potential provided by the tools in question. As can be seen in Table 8, the analysis carried out gave rise to eight different categories that portray the different areas of practical application of technologies with educational potential.

Table 8. The tool categories.

Tool Categories	Dissertations		Tools	
	N	%	N	%
Web and social networks	101	28.7	18	13.0
Online learning platforms and environments	67	19.0	23	16.7
Technologies to support multimedia and network communication	48	13.6	15	10.9
Systems, means, and technological devices	39	11.1	13	9.4
Repositories, resources, and educational software	37	10.5	26	18.8
Programming, modelling, and electronics	37	10.5	24	17.4
Tools for producing, organising, and viewing digital content	16	4.5	14	10.1
Virtual reality and augmented reality	7	2.0	5	3.6
Total	352 *	100.0	138	100.0

Key: * The total value is higher than the number of dissertations that reference the technologies previously mentioned (n = 261 dissertations) because, in some studies, more than one technology/tool is referred to.

Out of all the tools included per dissertation, the "Web and Social Networks" category comprises the largest *corpus*, and is mentioned in 101 of the studies analysed (more than a quarter of all the dissertations). This category includes a set of 18 web-based technologies, practices, and strategies, and which are supported on social networks, using tools and services such as Facebook, Google+, Twitter, YouTube, Wiki, Wikipedia, and other applications available on the cloud.

"Online Learning Platforms and Environments" are in second place, being mentioned in 67 dissertations that make reference to a wide range of technologies. As is confirmed in Table 8, in this area, 23 tools were grouped together that specifically involve platforms and virtual environments designed to facilitate the online teaching and learning process. Considering only the references to the systems and environments used or developed in

each case, there is a concentration of studies centred around the use of "Moodle" (15). With a lower frequency, but also mentioned in more than one dissertation, are references to MOOC (3), the Aulanet Platform (3), the Elgg Platform (2), and SAPO Campus (2).

Next comes the "Technologies to support multimedia and network communication" category, with 15 separate tools that feature in 48 dissertations. This area of practical application of technologies covers tools that support the communication and exchange of information in digital networks. As well as a general reference to ICT (in 22 dissertations), the topics brought up lead to the discussion of tools to support synchronous communication (e.g., chat, videoconferencing, Adobe Connect Pro) and asynchronous communication (e.g., chat, email, forums), and references are made to technology-based means and programs of communication (e.g., television studio, casting technologies, streaming programs).

In fourth place, we have the "Systems, means and technological devices" category, which brings together a total of 13 tools that are discussed in 39 dissertations. In these studies, the focus falls mainly on technologies that allow mobility and portability, facilitating interaction and communication in the teaching and learning process. As well as the reference to "Mobile devices" (13), a strong focus is also placed on "Smartphones" (5) and "Tablets" (3). Also noteworthy in this area are the references to two technologies that mark milestones in the history of technology integration in schools in Portugal, namely the "Interactive Blackboard" (6) and the "Magalhães Laptop" (2), both adopted in many Portuguese schools as part of a drive for technological modernisation and digital integration in the classroom.

In fifth place is the "Repositories, Resources and Educational Software" category. Present in 37 dissertations, this category brings together 26 tools usually used to enrich the teaching and learning process, enabling access to educational material and digital content available in online content management systems, libraries, and repositories. As well as more generic references, such as "Digital Educational Resources" (4), "Open Educational Resources" (2), "Educational Software" (3), and "CD-ROM" (3), also part of this category are tools used with guided goals for certain school subjects, such as Geogebra (3), Geographical Information Technology (1), and platforms to support language learning (e.g., Babbel, Busuu, Duolingo, and Speak English Daily).

The "Programming, Modelling and Electronics" category is in sixth position and is also present in 37 dissertations. The category includes references to 24 tools that support the development of practices and strategies based on programming, modelling, and electronic activities. Within the scope of programming, "Computational programming" (3), and references to "Robots" (4) and "Scratch" (2) stand out. As for modelling and electronics, references to "Simulations" (5), "Sensors" (2), and "Applets" (2) come to the fore.

In the "Tools for producing, organising and viewing digital content" category, a total of 16 dissertations make reference to 14 different tools, which have the common thread of supporting the creation and management of digital content. "Data viewing tools" (2) and "Copyright software" (2) are the most frequently mentioned terms in this area. Also noteworthy is a category of references to specific tools, namely "Spreadsheets", "Google forms", "Kahoot!", and "Socrative", which are usually used to facilitate the assessment and monitoring of students' individual progress.

Lastly, we have the "Virtual Reality and Augmented Reality" category. Very seldom mentioned in this *corpus* of analysis (seven dissertations), this category consists of only five tools that enable immersive and highly interactive educational experiences. Within this scope, references are made to "Augmented Reality" and "Virtual Reality" as having high pedagogical potential to create significant learning environments. As a whole, the technologies that make up part of this category provide innovative resources that can transform the ways in which teaching and learning in an educational setting take place.

3.2.6. What Theoretical Frameworks Serve as the Foundation for the Studies?

Looking at the results presented in Table 9 in relation to the theoretical frameworks that underpin the studies under analysis, it is important to point out, right away, a concentration

of dissertations in three categories—"Missing", "Other referrals", and "Multireference framework"—that cover 69.7% of the dissertations.

Table 9. The theoretical frameworks.

Theoretical Frameworks	N	%
Behavioural	0	0.0
Communicational	14	3.7
Cognitivism/constructivism	46	12.1
Connectivism	26	6.8
Hypermedia/multimedia	9	2.4
Instructional design	19	5.0
Systemic perspective	1	0.3
Multireference	49	12.9
Others	93	24.5
Missing	123	32.4
Total	380	100.0%

This result, as well as highlighting the complexity inherent to the construction of the identity that characterises the field of TE, is symptomatic of the difficulty in identifying the theoretical framework underpinning the studies, either through omission (32.4%) or due to allusion to reference frameworks not initially included in our system of analysis (24.5%), or through allusion to a plurality of theoretical perspectives underpinning the studies (12.9%). The choice to include just one of the theoretical framework structures of our plan of analysis occurs in 30.3% of the dissertations. Among this small set of dissertations, a predominant number are underpinned by references linked to "Cognitivism/constructivism" (12.1%), "Connectivism" (6.8%), and "Instructional Design" (5%). Dissertations theoretically supported by "Communicational" (3.7%), "Hypermedia/multimedia" (2.4%) and "Systemic" (0.3%) perspectives show extremely residual values. Lastly, it is noted that there is an absence of theoretical dissertations exclusively focusing on the "Behavioural" approach.

3.3. University Contexts

In this section, we break down how the dissertations are spread across the different universities. As mentioned earlier, and to better understand the Portuguese reality as regards doctoral degrees in this scientific area, we take advantage of the opportunity to describe these contexts in terms of the Ph.D. courses and specialities, the number of supervisors involved, and the type of supervision adopted.

3.3.1. Which Institutions Provide the Academic Settings for the Investigated Dissertations?

As can be seen in Table 10, the total number of Ph.D. dissertations included in the analysis (380) is spread between on 17 university institutions (around 14% of the total number of Portuguese universities). There is a clear imbalance between the two types of contexts considered, with almost all of the dissertations (93.4%) carried out in the 13 public universities that offer a Ph.D. in this area. The universities from the private network account for the remaining 6.6% of the dissertations.

The University of Minho, with 22.9% of the dissertations, is the institution where the highest number of dissertations were carried out, followed by the University of Aveiro, with 20%. These two universities account for around half of the dissertations conducted in Portugal in the field of TE. A little over one quarter of the dissertations (26.8%) were carried out in two universities, comprising the University of Lisbon (14.2%) and the Open University, with 12.6%. The rest of the public universities can also be split into two categories. One category produced around one fifth of the dissertations (21.9%), consisting of the Universities of Nova Lisbon, Porto, Coimbra, and Évora, and the other category contains all the others, where just 2.7% of the dissertations were carried out.

Table 10. The Ph.D. dissertations according to their university context.

Higher Education	Institutions	Dissertations	
		N	**%**
	UM	87	22.9
	UA	76	20.0
	UL	54	14.2
	UAb	48	12.6
	UTAD	19	5.0
	UNL	18	4.7
Public network (n = 13)	UC	16	4.2
	UP	15	3.9
	UE	12	3.2
	UBi	4	1.1
	UMad	3	0.8
	ISCTE	2	0.5
	UAç	1	0.3
	Subtotal	355	93.4
	ULHT	10	2.6
Private network (n = 4)	UCP	9	2.4
	UPIH	5	1.3
	ISPA	1	0.3
	Subtotal	25	6.6
	Total	380	100.0

Key: UM, University of Minho; UA, University of Aveiro; UL, University of Lisbon; UAb, Open University; UTAD, University of Trás-os-Montes e Alto Douro; UNL, Lisbon Nova University; UC, University of Coimbra; UP, University of Porto; EU, University of Évora; Ubi, University of Beira Interior; UMad, University of Madeira; ISCTE, University Institute of Lisbon; UAç, University of Azores; ULHP, Lusophone University of Humanities and Technology; UCP, Portuguese Catholic University; UPIH, Universidade Portucalense Infante D. Henrique; ISPA, Institute of Applied Psychology.

3.3.2. Which Specific Ph.D. Courses and Specialities Do These Dissertations Align with?

In relation to the Ph.D. courses for which the research is undertaken, Table 11 shows that more than two thirds (71.6%) are in courses related to Education Sciences or Education, and most are undertaken in public higher education institutions, which account for 93.4% of the dissertations. Almost half of these are carried out at the University of Minho, the University of Lisbon, and the Open University, which account for 20.0%, 13.9%, and 12.6%, respectively. In second place, and responsible for 17.4% of the dissertations conducted in the area of TE, is the Multimedia in Education course provided by the University of Aveiro.

The courses included in the "Others" category, accounting for 11.1% of the dissertations, predominantly comprise courses of a didactic nature related to education, mainly in the area of Sciences and Child Studies. While the course in Child Studies is one of the two Ph.D. offers at the University of Minho (in this case, the Institute of Education), the courses in the areas of Teaching or Didactics of the Sciences are specific offers distributed around the different Science Schools or Faculties of the Universities of Porto, Coimbra, Aveiro, UTAD, and Nova Lisbon.

In order to gain a better understanding of the context in which the Ph.D. research is carried out, we deem it relevant to broaden the scope to the specialities that are offered in the different courses, and how they are distributed in the different institutions. This is what we attempt to do in Table 12, with the categories of analysis limited to five for operational reasons, to facilitate the analysis while seeking to respect the essence of each speciality (the original names are shown on the table key) and its distinctive elements.

Table 11. The dissertations per institution and course.

University Context		Ph.D. Course			
Network	Institution	Education Sciences or Education	Multimedia in Education	Others *	Total
Public	UM	76 (20.0)	-	11 (2.9)	87 (22.9)
	UA	7 (1.9)	66 (17.4)	3 (0.8)	76 (20.0)
	UL	53 (13.9)	-	1 (0.3)	54 (14.2)
	UAb	48 (12.6)	-	-	48 (12.6)
	UTAD	15 (3.9)	-	4 (1.1)	19 (5.0)
	UNL	15 (3.9)	-	3 (0.8)	18 (4.7)
	UC	14 (3.7)	-	2 (0.5)	16 (4.2)
	UP	5 (1.3)	-	10 (33.3)	15 (3.9)
	UE	7 (1.9)	-	5 (2.6)	12 (3.2)
	UBi	4 (1.1)	-	-	4 (1.1)
	UMad	3 (0.8)	-	-	3 (0.8)
	ISCTE	-	-	2 (0.5)	2 (0.5)
	UAç	1 (0.3)	-	-	1 (0.3)
	Subtotal	248 (65.3)	66 (17.4)	41 (10.8)	355 (93.4)
Private	ULHT	9 (2.4)	-	1 (0.3)	10 (2.6)
	UCP	9 (2.4)	-	-	9 (2.4)
	UPIH	5 (1.3)	-	-	5 (1.3)
	ISPA	1 (0.3)	-	-	1 (0.3)
	Subtotal	24 (6.3)		1 (0.3)	25 (6.6)
	Total	272 (71.6)	66 (17.4)	42 (11.1)	380 (100.0)

Key: * Child Studies (11), Science Teaching (2), Teaching and Dissemination of the Sciences (9), Didactics of Sciences and Technologies (10), Information and Communication in Digital Platforms (1), Didactics (1), Didactics of Languages (1), Physical Education and Sport (1).

Table 12. The dissertations per context and speciality area.

University Context		Speciality Area							
Network	Institution	ET	ICTE	EC	DE	PE	Others	NS	Total
Public	UM	74 (19.5)	8 (2.1)	-	-	1 (0.3)	3 (0.8)	1 (0.3)	87 (22.9)
	UA	-	-	-	-	1 (0.3)	3 (0.8)	72 (18.9)	76 (20.0)
	UL	-	43 (11.3)	-	-	1 (0.3)	10 (2.6)	-	54 (14.2)
	UAb	-	-	7 (1.8)	34 (8.9)	-	6 (1.6)	1 (0.3)	48 (12.6)
	UTAD	1 (0.3)	-	-	-	-	-	18 (4.7)	19 (5.0)
	UNL	-	5 (1.3)	-	-	1 (0.3)	10 (2.6)	2 (0.6)	18 (4.7)
	UC	3 (0.8)	4 (1.1)	-	-	1 (0.3)	8 (2.1)	-	16 (4.2)
	UP	-	-	-	-	-	9 (2.4)	6 (1.6)	15 (3.9)
	UE	1 (0.3)	-	-	-	-	1 (0.3)	10 (2.6)	12 (3.2)
	UBi	-	-	-	-	-	-	4 (1.1)	4 (1.1)
	UMad	-	-	-	-	-	-	3 (0.8)	3 (0.8)
	ISCTE	-	-	-	-	-	-	2 (0.6)	2 (0.5)
	UAç	1 (0.3)	-	-	-	-	-	-	1 (0.3)
	Subtotal	80 (21.1)	60 (15.8)	7 (1.8)	34 (8.9)	5 (1.3)	50 (13.2)	119 (31.3)	355 (93.4)
Private	ULHT	-	-	-	-	-	1 (0.3)	9 (2.4)	10 (2.6)
	UCP	-	-	-	-	-	-	9 (2.4)	9 (2.4)
	UPIH	-	-	-	-	-	2 (0.6)	3 (0.8)	5 (1.3)
	ISPA	-	-	-	-	-	1 (0.3)	-	1 (0.3)
	Subtotal	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (1.1)	21 (5.5)	25 (6.6)
	Total	80 (22.5)	60 (15.8)	7 (1.8)	34 (8.9)	5 (1.3)	54 (14.2)	140 (36.8)	380 (100.0)

Key: ET, Educational Technology [(i) Educational Technology, and (ii) Educational Technology and Curricular Development]; ICTE, Information and Communication Technologies in Education [(i) Educational and Communication Technologies; (ii) Information and Communication Technologies; (iii) Information and Communication Technologies in Education; and (iv) Technologies, Networks and Multimedia in Education and Training]; EC, Educational Communication [(i) Educational Communication, and (ii) Communication in Education]; DE, Distance Education [Distance Education and E-Learning]; PE, Psychology of Education; NS, no speciality.

The table illustrates that the "Educational Technology" (ET) category, referring to the speciality area of the same name offered originally by the University of Minho and, subsequently, by four other universities (UC, UE, UTAD, and UAç), leads the ranking, with 22.5% of the total dissertations carried out. In second place, with 15.8%, comes the category with the name of the speciality adopted at the University of Lisbon, "Information and Communication Technologies in Education" (ICTE), and which, as can be seen in the table key, brings together three other, somewhat similar, variations used at the Universities of Minho, Lisbon Nova, and Coimbra.

In third place, with 8.9% of the dissertations, is the "Distance Education" (DE) category, referring to the speciality area of the same name offered exclusively by the Open University. Accounting for small percentages are the categories of "Educational Communication" (CE), a speciality offered only by the Open University (1.8%), and "Psychology of Education" (PE), with 1.3%, which is offered by five public institutions (UM, UA, UL, UNL, and UC). The highest value in the table, however, belongs to the cases where there is no, or no explicitly mentioned, speciality area (NS), accounting for over a third of the dissertations (36.8%).

3.3.3. Which Supervision Models Are Most Commonly Used in the Research Process?

To further deepen our knowledge of the research context, we deemed it important to consider the supervisors involved, and the type of supervision implemented, in the different institutions.

Based on Table 13, one can observe that the traditional supervision model, in which a Ph.D. is supervised by a single supervisor, tends to prevail, accounting for 63.5% of the cases. Co-supervision, involving two or three supervisors, took place in 36.5% of the dissertations analysed.

Table 13. The dissertations per institution, supervisors, and type of supervision.

University Context		Dissertations with Supervision	Supervision Type		Supervisors Involved
Network	Institution		Individual	Co-Supervision	
Public	UM	87	55 (63.2)	32 (36.8)	43
	UA	(75)	30 (40.0)	45 (60.0)	43
	UL	54	44 (81.5)	10 (18.5)	25
	UAb	48	40 (83.3)	8 (16.7)	24
	UTAD	19	6 (31.6)	13 (68.4)	23
	UNL	18	9 (50.0)	9 (50.0)	18
	UC	16	8 (50.0)	8 (50.0)	18
	UP	(14)	13 (92.9)	1 (7.1)	8
	UE	12	8 (66.7)	4 (33.3)	13
	UBi	4	3 (75.0)	1 (25.0)	4
	UMad	3	1 (33.3)	2 (67.7)	5
	ISCTE	2	-	2 (100.0)	3
	UAç	1	-	1 (100.0)	2
	Subtotal	353	217 (61.5)	136 (38.5)	229
Private	ULHT	10	9 (90.0)	1 (10.0)	10
	UCP	9	8 (88.9)	1 (11.1)	3
	UPIH	5	5 (100.0)	-	5
	ISPA	1	1 (100.0)	-	1
	Subtotal	25	23 (92.0)	2 (8.0)	19
	Total	378	240 (63.5)	138 (36.5)	248

Key: In the calculation of the UA, only 75 dissertations were included, given that one dissertation was completed autonomously, without supervision. In the UP, only 14 were considered, given that one dissertation did not contain any information about the supervisor(s).

Comparing the results between the public and private universities, we can see that there is less of a split in the public network (61.5% versus 38.5%) than the private, where

there is a clear preference for a single supervisor (92.0% versus 8.0%). It is pointed out that a single supervisor is clearly the preferred model for around half of the public institutions: at the UM, with a difference of 63.2% vs. 36.8%; the UL, 81.5% vs. 18.5%; the UAb, 83.3% vs. 16.7%; the UP, 92.9% vs. 7.1%; the EU, 66.7% vs. 33.3%; and, finally, at the Ubi, 75.0% vs. 25.0%.

With regard to the institutions belonging to the public higher education network, two other different configurations were detected. In one, there is a clear preference for co-supervision, i.e., a model based on collaboration among supervisors, especially in UTAD (68.4% vs. 31.6), UA (60.0% vs. 40.0%), and UMad (67.7% vs. 33.3%). All the dissertations carried out at ISCTE and UAç, totalling three, were supervised in a co-supervision regime. Another trend was noted that comprised a balance between individual supervision and co-supervision, as seen in two universities, the UNL and UC, both of whom had 50% of each supervision type. As mentioned in the key in Table 13, a particular case is pointed out where the Ph.D. dissertation was proposed by the author himself (UA), which is an option permitted by Portuguese law.

4. Discussion

In this study, we sought to analyse all the Ph.D. dissertations produced in Portugal in the scientific area of Education that focused on TE. As a pioneering research project in our country, we deliberately opted not to establish any cutoff time, deciding that all dissertations registered by the end of 2022 that met the selection criteria, defined throughout the process to compile the *corpus* of the analysis, would be included. Therefore, based on a total of 380 doctoral dissertations produced in the field of TE between 1997 and 2022, this study is the first of a series of projects we intend to carry out to deepen the understanding of the panorama related to the evolution of the research in the field of TE. This work aims to provide a broad and sufficiently detailed picture of a set of variables that we have broken down into three dimensions of analysis: the authors and dates of the dissertations, the issues studied, and the university contexts.

With regard to the first dimension, referring to the authors and dates of the dissertations, we found that, despite the prevalence of Portuguese authors, as was to be expected, a large proportion of the scientific-academic production carried out in the Portuguese universities—around one third—is undertaken by international students, almost all of whom come from Portuguese-speaking countries, with Brazil by far the most represented country. This finding, as well as probably reflecting the impact of the marketing strategies implemented by Portuguese universities in recent years to attract new students, also highlights the emergence of an internationalisation component in the scientific production in TE, which is likely to continue in the future, as can be deduced from the knowledge produced in the universities themselves regarding the profiles of the students who apply to Portuguese higher education institutions.

While this topic is not given much emphasis in the literature reviewed, we believe that this international component will certainly lead to a wider diversity of questions, issues, motivations, interests, and reference frameworks that will naturally be reflected in the research in TE and, therefore, justifies an autonomous analysis approach in future work.

With respect to the first dimension, there is a noticeable gender gap between the authors of education Ph.Ds., with a clear preponderance of female authors. This finding, which illustrates women's willingness to carry out advanced studies, when compared with the results available in the literature that show the predominance of the male gender in the scientific production in TE in Portugal and elsewhere [28,36], seems to indicate that the willingness of women to carry out advanced studies is not borne out, subsequently, in the sharing and dissemination of the knowledge produced during the Ph.D. courses, namely through the publication of scientific articles.

Finally, by examining the evolution of the number of dissertations produced per year, we find that the first decade (1997–2007) mirrored a process whereby the research into TE started to affirm itself, albeit with a degree of instability, with a very slight upward trend

in the number of dissertations and a few interruptions to this trend. It is pointed out that only from 2010 onwards was there a significant expansion in the scientific production of the studies under analysis, culminating in the highest number of dissertations in 2018. As a whole, the growth in the number of works recorded from 2010 onwards confirms what other bibliographical reviews had found in the field of TE in general [6,7,28].

In relation to the second dimension, relative to the issues studied, and as we pointed out earlier, we have taken as our reference point a diversified set of aspects aimed at characterising and deepening knowledge about the academic research carried out in the third study cycle. The idea was that an articulated analysis of these different aspects would provide an overview of what is being studied, helping us understand to what extent this research, as we wrote in the Introduction, can boost the capacity for innovation in the search for solutions to the challenges raised by the use of digital technologies and how to consolidate and lay the groundwork for changes in educational practices.

Along these lines, it is important to point out right away that the findings do not allow us to conclude that the research undertaken in TE for Ph.D. courses in Portugal focuses mainly on experimentation on and/or analysis of the potential of emerging technologies. Despite the fast changes and the rise in the rate of technological innovation in different sectors that also have an impact on educational practices [6], in our study, it is especially noteworthy how many dissertations tackle topics related to the "Teaching and Learning" process itself, in which digital technologies are explored regarding concerns of a curricular nature (literacy, teaching and learning with technologies strategies, digital assessment, etc.).

We note, as observed on the international level, that most dissertations focus on problems and issues related more to the pedagogical and didactic aspect inherent to the infusion of technology in educational and training processes than to problems of a more technological nature (when the focus is on the technology, at least at first glance, it seems to constitute the end in itself). Alkraiji and Eidaroos, for example, note that, even in studies more geared towards the analysis of sociotechnical systems, with an emphasis on the interaction between people or organisations and technical innovation, concerns about pedagogical issues are much more pressing than questions of a technological nature [28]. Likewise, the findings of the research conducted by Lai and Bower clearly highlight the focus on questions related to learning results, also showing the greater efficacy of pedagogical approaches that involve interaction, gamification, constructivism, learning centred on the student, and feedback [12].

In our study, the reduced focus on the technological dimension is also demonstrated by the considerable number of dissertations that make no explicit reference to the tools (around a third of the *corpus* analysed), and for those that place a more explicit emphasis on the tools, their references are concentrated in two categories, namely "Web and Social Networks" and "Online Learning Platforms and Environments", suggesting a stronger approximation to the so-called short-term trends outlined in the Horizon Reports of 2011, 2013, and 2014 [6].

In the light of international trends and forecasts, this focus on tools that do not reflect the most recent technologies may indicate the inability of the research to respond quickly enough to tackle the new practices, but it may also translate to an inflexion in the logic behind the idea of automated pedagogical practices encouraged by fascination about how (new) technologies impact our lives, which is well documented in the literature [10].

Finally, another facet that must be highlighted within the scope of the issues studied is linked to the necessary reflection on the role of theory in the construction of knowledge in the field of TE. The findings of this study show that the more traditional theoretical bases that are deemed more important in the evolution of this area [34] are not particularly evident. The theoretical foundations that are most frequent, but are far from having a significant presence, are anchored in references that allude to presuppositions and principles that underpin cognitivist and constructivist theories.

However, the most intriguing result of this study, which corroborates the results from other research [15,29,33], is the absence of an explicit theoretical orientation. In our case,

around one third of the dissertations did not seem to align themselves with any specific theory or theoretical reference point. A possible interpretation of these results, as pointed out by other studies in the field of TE [15], may be related to a free and open spirit in the researchers, allowing them to forge new approaches (theoretical and methodological) that are often not limited to a strictly disciplinary point of view. This hypothesis seems equally relevant to helping us explain the emergence of a pattern that mirrors and, in a certain sense, validates the interdisciplinary nature of TE, which is shown both in the research [11,17] and in the post-graduation offers available [4,5].

With regard to the third dimension, focused on analysing and describing the institutional contexts in which the dissertations are carried out, the results show that public universities are clearly paving the way in knowledge production in the area of TE in Portugal. The University of Minho and the University of Aveiro play leading roles in advancing knowledge in this specific field, together accounting for almost half the dissertations carried out. The University of Lisbon and the Open University also play significant roles in the production of dissertations in this field, together contributing just over a quarter of the total number.

Several factors may help explain why these four institutions are so active in the research into TE in Portugal. In addition to their academic reputation in the area under analysis, they are institutions that have sought to establish a range of collaborations and partnerships to develop teaching and research projects, as well as having academic departments specialised in TE and/or research centres that attract researchers and scholarship students who are interested in this field.

With respect to the doctoral courses within which the research is carried out, we see that more than two thirds of the dissertations are for courses related to Education Sciences or Education. The University of Minho, the University of Lisbon, and the Open University are where almost half of the dissertations are produced, and also noteworthy is the Multimedia in Education course offered by the University of Aveiro, which accounts for around one sixth of the dissertations produced in TE.

The analysis carried out also enables different speciality areas to be identified, of which "Educational Technology" is the most common, followed by "Information and Communication Technologies in Education". However, it should be pointed out that, in one third of the dissertations that comprise the *corpus* of analysis of this study, no speciality area was explicitly mentioned. This finding, as well as being an indicator that reflects a research dynamic that transcends the logic of specialised knowledge in TE [11,17], also helps us to understand the difficulty felt in relation to categorising the dissertations by linking them to conceptual structures that traditionally characterise the specificity of the TE area.

In any event, as other studies have suggested, it is certainly a reflection of the changeable evolution and nature of the research areas, which can be viewed as an enrichment of the field, enabling the integration of wide-ranging perspectives and the emergence of new approaches [19].

In this study, the emergence of new approaches also manifests itself clearly in the ways in which the dissertations are supervised. Despite the prevalence of the traditional supervision model, co-supervision comes to the fore as an increasingly adopted practice in the institutions where the dissertations are produced and, above all, in the universities that belong to the higher education public network. Although it is necessary to explore the factors that influence the choice between individual supervision and co-supervision in more depth, this finding seems to reflect a greater emphasis given to diversity in perspectives, experiences, knowledge, and support during the research process.

5. Conclusions

Based on the results and discussions, this section summarises the key contributions of this comprehensive study on doctoral research in TE. The conclusions are organised

according to the three research dimensions outlined in this work: authors and dissertations, issues studied, and university contexts.

Authors and Dissertations: This investigation highlights the evolving landscape of TE research in Portugal. Notably, the internationalisation of this research field has become increasingly evident, with a growing number of contributions from foreign students, particularly those from Portuguese-speaking countries, such as Brazil. This phenomenon underscores the emergence of a diverse and globally informed research community in Portugal. Moreover, a striking observation is the pronounced gender disparity among authors, as female scholars have shown a strong commitment to advancing their expertise in TE. This departure from the global trend, where male authors typically dominate TE research, suggests that Portuguese women actively engage in advanced TE studies, contributing to a more balanced and inclusive research environment. Furthermore, our analysis of the temporal evolution of TE dissertations over a quarter of a century, from 1997 to 2022, underscores the field's growth and maturation in Portugal. A significant upswing in the research output since 2010 signifies the expanding interest and commitment from researchers when it comes to exploring the multifaceted dimensions of TE, setting the stage for further advancements in the field.

Issues Studied: Delving into the thematic landscape of TE research, this study uncovered a diverse array of themes. Notably, "Teaching and Learning" and "Professional Development" have emerged as dominant areas of investigation. These thematic preferences signify a deliberate departure from a predominantly technology-orientated viewpoint, with an emerging emphasis on pedagogical aspects. Within the Portuguese research landscape, there is a growing trend of investigating the potential of technology to augment the educational process and, simultaneously, cater to the professional growth requirements of educators. Additionally, our findings reveal that researchers predominantly derive their research problems from real educational contexts. This practice demonstrates a commitment to bridging the gap between theory and practice and reflects the field's practical relevance. Researchers are actively striving to enhance their comprehension of educational challenges and develop impactful interventions that can have a positive influence on the realms of teaching and learning.

University Contexts: In the context of universities in Portugal, this study recognises key institutions, such as the University of Minho and the University of Aveiro, as driving forces in the advancement of TE research. These institutions possess academic departments and research centres dedicated to TE and foster collaborations and partnerships that stimulate innovative teaching and research projects. The prevalence of co-supervision models in these institutions underscores their commitment to diverse perspectives, experiences, and collaborative support during the research process.

In conclusion, the emphasis on practical relevance, pedagogical considerations, and international collaboration not only enriches educational research in Portugal but also has significant implications for the global research landscape in education. These implications include the development of innovative research approaches and the strengthening of research networks in universities aimed at jointly addressing real-world issues in the field of education. In this regard, this research not only enriches academic discourse, but also provides valuable insights for education professionals, policymakers, and stakeholders seeking to harness the potential of technology to improve learning outcomes and shape the future of education.

References

1. Cardoso, S.; Tavares, O.; Sin, C.; Carvalho, T. *Structural and Institutional Transformations in Doctoral Education: Social, Political and Student Expectations*; Palgrave Macmillan: Cham, Switzerland, 2020; XXIX, 397.
2. Singh, R.; Srivastava, R. Content Analysis of Doctoral Dissertations in Library and Information Science. *Mark. Inf. Prod. Serv.* **2021**, *6*, 207–210.
3. Selwyn, N.; Hillman, T.; Eynon, R.; Ferreira, G.; Knox, J.; Macgilchrist, F.; Sancho-Gil, J.M. What's next for Ed-Tech? Critical hopes and concerns for the 2020s. *Learn. Media Technol.* **2020**, *45*, 1–6. [CrossRef]
4. Cardoso, S.; Santos, S.; Diogo, S.; Soares, D.; Carvalho, T. The transformation of doctoral education: A systematic literature review. *High. Educ.* **2022**, *84*, 885–908. [CrossRef]
5. Pammer-Schindler, V.; Wild, F.; Fominykh, M.; Ley, T.; Perifanou, M.; Soule, M.; Hernández-Leo, D.; Kalz, M.; Klamma, R.; Pedro, L.; et al. Interdisciplinary Doctoral Training in Technology-Enhanced Learning in Europe. *Front. Educ.* **2020**, *5*, 150. [CrossRef]
6. Dubé, A.K.; Wen, R. Identification and evaluation of technology trends in K-12 education from 2011 to 2021. *Educ. Inf. Technol.* **2022**, *27*, 1929–1958. [CrossRef]
7. Gündüz, A.; Gündüzalp, C.; Koçak, Ö.; Göktaş, Y. Educational Technology Research Trends: A 10-Year Content Analysis of PhD Dissertations. *Particip. Educ. Res.* **2023**, *10*, 140–159. [CrossRef]
8. Scanlon, E. Educational technology research: Contexts, complexity and challenges. *J. Interact. Media Educ.* **2021**, *2021*, 1–12. [CrossRef]
9. Yildiz, E.P.; Cengel, M.; Alkan, A. Current trends in education technologies research worldwide: Meta-analysis of studies between 2015–2020. *World J. Educ. Technol. Curr. Issues* **2020**, *12*, 192–206. [CrossRef]
10. Castañeda, L.; Salinas, J.; Adell, J. Hacia una definición contemporánea de la Tecnología Educativa. *Digit. Educ. Rev.* **2020**, *37*, 240–258. [CrossRef]
11. Marín, V.I.; Buntins, K.; Bedenlier, S.; Bond, M. Invisible borders in educational technology research? A comparative analysis. *Educ. Technol. Res. Dev.* **2023**, *71*, 1349–1370. [CrossRef] [PubMed]
12. Lai, J.W.M.; Bower, M. Evaluation of technology use in education: Findings from a critical analysis of systematic literature reviews. *J. Comput. Assist. Learn.* **2020**, *36*, 241–259. [CrossRef]
13. Turan, Z.; Akdag-Cimen, B. Flipped classroom in English language teaching: A systematic review. *Comput. Assist. Lang. Learn.* **2020**, *33*, 590–606. [CrossRef]
14. Li, C.; Li, W. Learner Identity in Chinese as a Foreign/Second Language Education: A Critical Review. *Front. Educ. China* **2020**, *15*, 73–98. [CrossRef]
15. Costa, C.; Hammond, M.; Younie, S. Theorising technology in education: An introduction. *Technol. Pedagog. Educ.* **2019**, *28*, 395–399. [CrossRef]
16. Anderson, T.; Saunders, G.; Alexander, I. Alternative dissertation formats in education-based doctorates. *High Educ. Res. Dev.* **2022**, *41*, 593–612. [CrossRef]
17. Güngören, Ö.; Kaymak, Z.; İşbulan, O.; Tok, B.; Savaş, F.; Yildirim, S.; Elibol, N.; Tufançli, S.; Çivi, E.; Öztürk, İ. Topic Trends in Educational Technology Research (2015–2020). *Sak. Univ. J. Educ.* **2021**, *11*, 285–304. [CrossRef]
18. Papert, S. Teaching Children Thinking. *Innov. Educ. Train. Int.* **1972**, *9*, 245–255. [CrossRef]
19. Papert, S. What's the big idea? Toward a pedagogy of idea power. *IBM Syst. J.* **2000**, *39*, 720–729. [CrossRef]
20. Jonassen, D. *Computers as Mindtools for Schools: Engaging Critical Thinking*; Merrill: Upper Saddle River, NJ, USA, 2000.
21. Resnick, M. Rethinking Learning in the Digital Age. In *The Global Information Technology Report 2001–2002: Readiness for the Networked World*; Oxford University Press: New York, NY, USA, 2002; Chapter 3; pp. 32–37. Available online: https://cyber.harvard.edu/publications/2002/The_Global_Information_Technology_Report_2001-2002 (accessed on 25 May 2023).
22. Valverde-Berrocoso, J.; Fernández-Sánchez, M. Chapter 7: The Next Educational Technology. In *Innovation and ICT in Education*; River Publishers: New York, NY, USA, 2021; pp. 53–63. [CrossRef]
23. Weller, M. *25 Years of Ed Tech*; Athabasca University Press: Athabasca, AB, Canada, 2020; 224p. [CrossRef]
24. Bond, M.; Zawacki-Richter, O.; Nichols, M. Revisiting five decades of educational technology research: A content and authorship analysis of the British Journal of Educational Technology. *Br. J. Educ. Technol.* **2019**, *50*, 12–63. [CrossRef]
25. An, Y. A history of instructional media, instructional design, and theories. *Int. J. Technol. Educ.* **2021**, *4*, 1–21. [CrossRef]
26. Martin, S.; Diaz, G.; Sancristobal, E.; Gil, R.; Castro, M.; Peire, J. New technology trends in education: Seven years of forecasts and convergence. *Comput. Educ.* **2011**, *57*, 1893–1906. [CrossRef]

27. Kimmons, R.; Rosenberg, J. Trends and Topics in Educational Technology, 2022 Edition. *TechTrends* **2022**, *66*, 134–140. [CrossRef] [PubMed]

28. Alkraiji, A.; Eidaroos, A. Trends and Issues in Educational Technology Research in Saudi Higher Education: A Meta-Analysis Review. *J. Educ. Pract.* **2016**, *7*, 62–79.

29. Durak, G.; Cankaya, S.; Yunkul, E.; Misirli, Z. A content analysis of dissertations in the field of Educational Technology: The case of Turkey. *Turk. Online J. Distance Educ.* **2018**, *19*, 128–148. [CrossRef]

30. Aydemir, A.; Can, G. Educational technology research trends in Turkey from a critical perspective: An analysis of postgraduate theses. *Br. J. Educ. Technol.* **2019**, *50*, 1087–1103. [CrossRef]

31. Asdaque, M.; Rizvi, S. Exploring the Research Trends-Related Imbalances in Doctoral Level Research on Distance Education in Pakistan. *Pak. J. Distance Online Learn.* **2019**, *5*, 105–122.

32. Coutinho, C.; Gomes, M.J. Uma Análise da Investigação realizada no âmbito do Mestrado em Tecnologia Educativa da Universidade do Minho. In *Actas do XIV Colóquio da AFIRSE. Para um Balanço da Investigação em Educação de 1960 a 2005. Teorias e Práticas*; Afirse Portugal: Lisboa, Portugal, 2007; pp. 1–12.

33. Costa, F. Educational Technologies: Analysis of Master dissertations carried out in Portugal. *Sísifo Educ. Sci. J.* **2007**, *3*, 7–24.

34. Ross, S.; Morrison, G.; Lowther, D. Educational Technology Research Past and Present: Balancing Rigor and Relevance to Impact School Learning. *Contemp. Educ. Technol.* **2010**, *1*, 17–35. [CrossRef]

35. Costa, F. Tendências e Práticas de Investigação na Área das Tecnologias em Educação em Portugal. In *Investigação em Educação. Teorias e Práticas (1960–2005)*; Educa & UIDCE: Lisboa, Portugal, 2007; pp. 169–224.

36. Coutinho, C. Tecnologia Educativa em Portugal: Os primeiros passos de uma comunidade de investigação. In *Atas do Congresso da Sociedade Portuguesa de Ciências da Educação. Cenários da Educação/Formação: Novos Espaços, Culturas e Saberes*; Sociedade Portuguesa de Ciências da Educação: Porto, Portugal, 2005; pp. 1–18. Available online: https://hdl.handle.net/1822/6377 (accessed on 25 May 2023).

37. Rashid, S.; Rehman, S.; Ashiq, M.; Khattak, A. A Scientometric Analysis of Forty-Three Years of Research in Social Support in Education (1977–2020). *Educ. Sci.* **2021**, *11*, 149. [CrossRef]

38. Andriamamonjy, A.; Saelens, D.; Klein, R. A combined scientometric and conventional literature review to grasp the entire BIM knowledge and its integration with energy simulation. *J. Build. Eng.* **2019**, *22*, 513–527. [CrossRef]

39. Page, M.; McKenzie, J.; Bossuyt, P.; Boutron, I.; Hoffmann, T.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ* **2021**, *372*, 71. [CrossRef]

40. Cloutier, C.; Ravasi, D. Using tables to enhance trustworthiness in qualitative research. *Strateg. Organ.* **2021**, *19*, 113–133. [CrossRef]