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Classification of the Theses and Dissertations in the Field of Computer Education and Instructional Technology in Turkey: An Investigation through Text Mining

Volkan Kukul*

Department of Computer Education and Instructional Technology, Amasya University, Amasya, Turkey ORCID: 0000-0002-9546-3790

Kazım Anıl Aydın

Department of Technology and Innovation, Amasya University, Amasya, Turkey ORCID: 0000-0002-5191-182X

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The rapid development of technology has led changes in educational paradigms in many areas of daily life. With this change, the integration of technology into educational environments and the organization of resources and processes have gained more importance. This situation reveals the need for educational technologies. There is a need for studies that can take a snapshot of the field for researchers to have a better understanding of the field. According to this need, it is aimed to take a snapshot of the area through text mining analysis would provide a wider perspective of the field. The results showed that the analyses on the keywords and summaries of the studies indicated that three clusters were formed according to the summaries and five different clusters were formed according to the keywords. Based on the findings of the current study, the appearance of instructional design in the red cluster and its divergence from other clusters indicate a key finding in terms of the field. It can be concluded that instructional design is used in the design of distance education environments, but in other clusters, instructional design is not a priority. However, the researchers in this field are expected that instructional design principles should be employed for diverse issues such as teaching programming, language teaching, and the use of social media in learning environments.

Introduction

The rapid development of technology causes changes in educational paradigms in many

* Correspondency: volkan.kukul@amasya.edu.tr

areas of daily life. With this change, the integration of technology into educational environments and the organization of resources and processes have gained more importance. This could also be stated as the scope of the field of educational technology and included in the definition of the field. The Association for Educational Communications and Technology (AECT) defined the field as "the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources" (Richey, Silber, & Ely, 2008). The field of educational technology is affected by such areas as psychology and learning theories and the developments in technology (Gülbahar & Alper, 2009; Kucuk, Aydemir, Yildirim, Arpacik, & Goktas, 2013). It can additionally be characterized as an interdisciplinary field where different disciplines work together and are also affected by rapid technological developments. With these characteristics, it can be concluded that it has a wide application area (Wilson, 2012) and has a structure that can be intertwined with other disciplines (Bodily, Leary, & West, 2019).

The trends in such a dynamic area also change rapidly. Defining the field of educational technology, which is defined as an upper field that works with diverse disciplines, may seem difficult for novice researchers (Bodily, Leary, & West, 2019). For this reason, there is a need for studies that can take a snapshot of the field for researchers to have a better understanding of the field. Based on this purpose, there are generally studies conducted through the content analysis method (e.g. Çakmak et al., 2015; Gülbahar & Alper, 2009; Kucuk et al., 2013; Töngel, Aydın, Kara, & Çakır, 2020). Some of the studies also took a snapshot of the studies published in a specific journal (e.g. Alper & Gulbahar, 2009). However, the content analysis may be insufficient to determine the patterns in the studies. Considering this inadequacy, taking a snapshot of the area through text mining analysis would provide a wider perspective of the field. Accordingly, the aim of this study is firstly to describe the studies in the field by using numerical data, then to take a wider perspective of the field using text mining analysis. For this purpose, the following research questions are sought to be answered;

RQ1: What are the educational technology theses bibliometrics in Turkey?

RQ2: What are the taxonomies and themes in the educational technology theses?

RQ3: What are the trends and patterns of educational technology theses?

Researches on Educational Technology in Turkey

When the studies in the field of educational technology were examined in terms of the number of publications, it is observed that Turkey is ranked as one of the top countries. According to the findings of a survey conducted in the Scopus electronic database, Turkey is ranked as one of the top countries after the United States of America, Taiwan, the United Kingdom, and Australia (Bodily, Leary, & West, 2019). This makes it critical to examine the research trends of the studies in a constantly changing and developing field such as educational technology in Turkey (Çakmak et al., 2015; Kucuk et al., 2013). The analysis of the trend studies in the field showed that analyses were carried out on the studies conducted with the specified keywords in the databases selected for the purpose of the study (Alper & Gulbahar, 2009; Bodily et al., 2019; Kucuk et al., 2013). Since researchers generally prefer using content analysis, it may be taken naturally to focus their studies on specific databases and keywords. However, this method has a disadvantage in demonstrating a wider perspective on the field. Therefore, it would be useful to use methods that can work with larger data sets in this kind of study.

Bibliometrics

Bibliometric analysis is a method that summarizes the studies through the years in which they were published, the number of citations they received, the most publishing countries, universities, and so on (Keshaval, Gireesh & Gowda, 2008; Thelwall, 2008). Bibliometric studies have been criticized in terms of their feature that they only summarize the studies descriptively and do not take their content into account (Hung, 2012). For this reason, the researchers tried to cover the missing parts of the bibliometric studies by using the content analysis method in this type of trend studies. However, problems in terms of time and effort in content analysis studies cause the need for researches to use big data analysis such as text mining (Hung, 2012).

Text Mining

Text mining is one of the data mining techniques that reveal hidden and meaningful structures in the data (Gupta & Lehal, 2009; Hung, 2012). There are various algorithms in text mining that can be used based on the specified purpose (Aggarwal & Wang, 2011). Diverse algorithms such as clustering, topic mapping, and text summarization can be done with these algorithms (Hung, 2012). In this study, the clustering method was used because its aim is to classify the publications in terms of their subjects.

Methodology

Research Design

Based on the aim of this study, the text mining process consisted of 4 stages (see Figure 1). In the first stage, theses and dissertations were collected with the macro code written via javascript programming language. In the second stage, data were prepared for the analysis by data cleaning and text parsing. In the third stage, clustering and data analysis were performed and VOSviewer was used to determine the patterns in the data. The relationship between the clusters, universities, years, and thesis numbers was reused as an Excel document by interpreting them with the written javascript code. In the final stage, the study was concluded by the data visualization, interpretation, and reporting process.

Data Collection

Within the scope of the current study, the theses and dissertations in the field of Educational Technology were examined. The data were accessed by filtering the departments from the advanced search tab in the YÖK National Thesis Center. The gathered 874 theses were filtered to include title, advisor, university, directory, year, category, and summary information. To transfer the collected thesis links to the computer, a crawler macro was written on the Node.js javascript interpreter in javascript language and 874 thesis links were saved in the computer environment in HTML format.

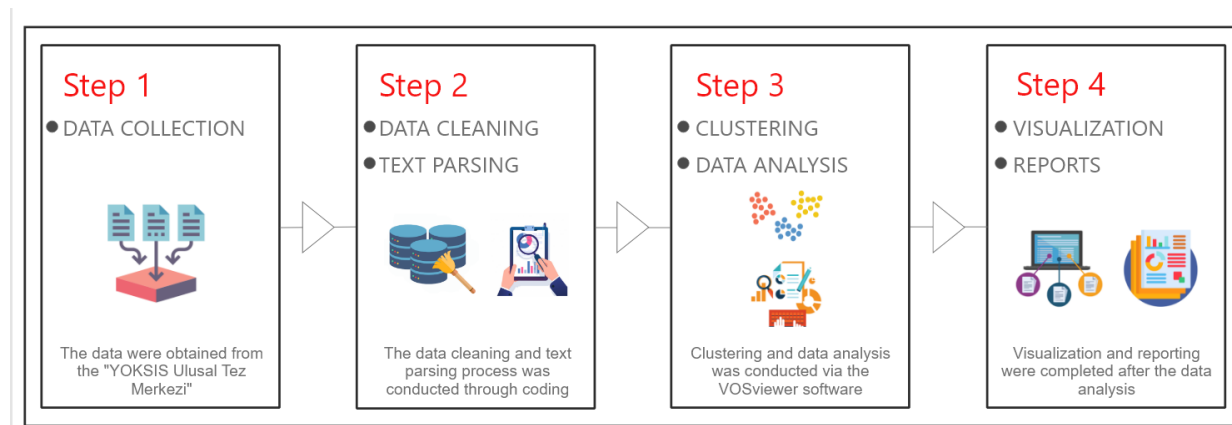


Figure 1. Text Mining Process

Data Analysis

In order to extract the required data from the thesis data stored in HTML format, the data merge tool was designed on Node.js to collect all the data in the form of an Excel document. Via this tool, the required data were converted into an Excel document within a single data set.

Before proceeding with the analysis of the data, the data were transformed via the program written through the javascript language on Node.js. All the data in the Excel data set were converted to lowercase before text preprocessing. During this transformation, statistical relations were determined and the new data sets were created. These data sets were interpreted and the process of transformation from data to information was provided and the other stage was initiated.

Findings

RQ1. What is the educational technology thesis bibliometrics in Turkey?

The bibliometric data of the studies were present in the tables below. The distribution of the studies by the years and levels were given.

Table 1. Descriptives Findings from the Theses

Years	f	%
2002	1	,1
2003	9	1,0
2004	11	1,3
2005	12	1,4
2006	14	1,6
2007	28	3,2
2008	35	4,0
2009	46	5,3
2010	75	8,6
2011	59	6,8
2012	79	9,0
2013	67	7,7
2014	68	7,8
2015	92	10,5
2016	86	9,8
2017	68	7,8
2018	69	7,9

2019	55	6,3
Total	874	100,0
Level	f	%
Master's	667	76,3
Ph.D.	207	23,7
Total	874	100,0

Table 1 shows that most of the theses were conducted in 2015 ($n = 92$, 10.5%), and the least of them was conducted in 2002 ($n = 1$, .1%). Considering that the field of educational technology in Turkey was established in 1998, the number in 2002 is a natural finding. The analysis on the levels of the theses showed that 667 (%76.3) theses are at the master's level and 207 (%23.7) of them are at the doctorate level.

The analysis further revealed that the theses are carried out in 33 universities. Compared with the other universities, 10 of these universities have the highest number of theses as they are the first universities where the Computer Education and Instructional Technologies (CEIT) departments were founded. The distribution of the theses conducted in these top universities was present in Table 2 according to the years.

Table 2. The distribution of the theses carried out in the top 10 universities

Universities	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Anadolu Uni					4	1	6	2	5	6	6	5	3	6	7	4	5	4	64
Ankara Uni							2	4	4	8	4	9	6	5	8	5	4	1	60
Atatürk Uni							2	2	6		5	2	7	19	12	7	3		65
Çukurova Uni			4	1	3	5	1	4	8	3	3	2	1	1	1				37
Gazi Uni			2			3	4	3	9	8	9	13	12	15	12	6		3	99
Hacettepe Uni			4	7		7	4	8	6	6	7	7	12	6	7	4	12	3	100
Karadeniz Technical Uni				1		2	2	1	3	7	7	2	5	4	7	6	6		53
Marmara Uni				1		1	4	5	14	2	1	3	3	2	3	2	3	3	47
Middle East Technical Uni	1	8				3	3	3	2	4	9	1		5	2	3	7	5	56
Sakarya Uni		1	1	2	3	2	4	9	10	4	5	13	5	7	5	5	4	3	83
Total	1	9	11	12	10	24	32	41	67	48	56	57	54	70	64	42	44	22	664

As shown in Table 2, most of the postgraduate theses are completed in Hacettepe University ($n = 100$, 11.44%). It is followed by Gazi University with 99 theses (11.32%) and Sakarya University with 83 theses (9.49%).

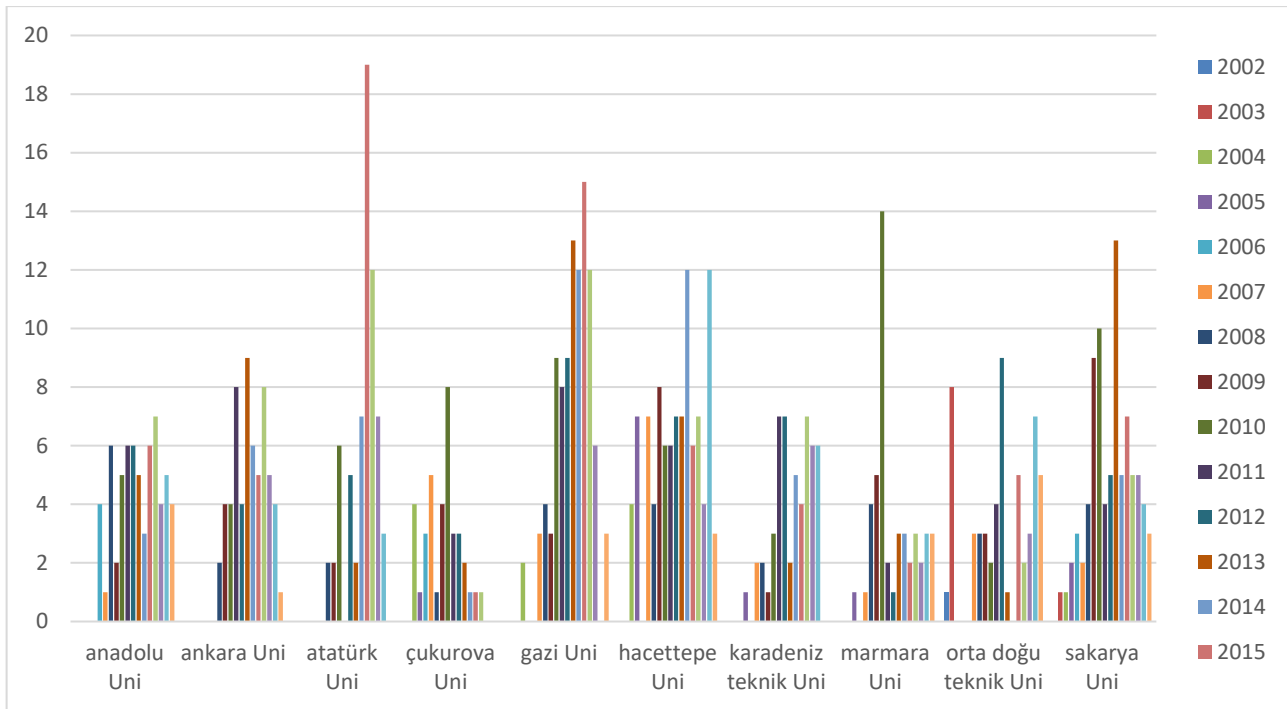


Figure 2. Thesis According to Top 10 Universities and Publication Years

In the studies within the theses, it was determined that 1923 keywords were used. Since the list of the keywords used in the studies is too long and unsuitable for this article, a table of the keywords used at least 30 times were illustrated in Table 3.

Table 3. The distribution of the keywords used at least 30 times

Keywords	f	Keywords	f
Academic Achievement	106	Student Attitude	41
Educational Technology	90	Instructional Technologies	41
Distance Education	83	Electronic Learning	40
Technology Usage	83	Instructional Methods	38
Student Achievement	80	Internet Usage	38
Internet	75	Achievement	35
Teachers	74	Secondary School Students	34
Computer Supported Instruction	73	Primary School Students	34
Computer Supported Education	72	Students	33
Education	67	Primary Schools	33
University Students	66	Assessment and Evaluation	32
Pre-Service Teachers	66	Learning Methods	31
Motivation	55	Web-Based Applications	31
Learning	48	Instruction	30
Technology	46	Online Learning	30
Web-Based Education	46	Self-Efficacy	30

Table 3 shows that the most used keyword is academic achievement ($n = 106$). Also, when it is considered that achievement and student achievement keywords are in the list in addition to academic achievement, academic achievement is the most frequently used variable in the theses in Turkey. This finding implies that graduate students aimed to investigate the effects of technologies or learning materials developed in the field on academic achievement. The reason

why education technology is the second most used keyword is that educational technology acts as an umbrella covering many subject areas (Hung, 2012). The analysis of the keywords also revealed that Distance Education is one of the most studied research areas in CEIT. According to the keywords used in the studies, university students are the most targeted population.

RQ2. What are the taxonomies and themes in the educational technology theses?

Cluster analysis, one kind of text mining, was used to find the answer to the second research question. The analyses were conducted for both summaries and keywords. As shown in Figure 3, the studies were divided into three clusters based on the summaries.

Qualitative and quantitative data, instructional design, interaction, observation, and interview elements were observed in the blue cluster. In the green cluster, academic achievement, achievement test, experiment group, control group, motivation, learning environment elements, and ANCOVA [Analysis of Covariance] were observed. This once again confirms that achievement is the most studied variable in educational technology research. In addition to achievement, motivation is also a most frequently studies variable and both variables were most studied experimentally.

In the red cluster, it is seen that there are elements such as Fatih Project, Teachers, Seniority, and Age. This situation can be interpreted as technology integration and the Fatih project are the most frequently studied research topics of this cluster. Besides, they are mostly studies as experimentally. Kruskal Wallis and Mann Whitney U tests, appeared in this cluster, imply that non-parametric tests are used in the studies performed here. This may be due to the insufficient number of teachers available in the studies. Besides, the demographics of the teachers such as seniority and age were also commonly investigated.

Cluster analysis of the keywords makes it easier to investigate the patterns of the studies in the field as subject areas. In clustering related to the keywords, five clusters were formed.

The concepts of Instructional design along with distance education, e-learning, web-based learning, and virtual environments were included in the red cluster. Based on this finding, it can be concluded that distance education applications were developed in the theses and that instructional design was used in the development of these environments. In addition, interaction, achievement, and cognitive load concepts were also included in this cluster. Considering the study areas it contains, the red cluster was labeled as distance education.

The yellow cluster includes the concepts of Social Networks, Facebook, internet usage, and cyberbullying. The widespread use of Facebook in Turkey has brought Facebook to the fore in the use of social networks in educational technologies (Mazman & Koçak-Usluel, 2010). It was also observed in the thesis that social networks and cyberbullying studies were used together. The inclusion of high school students in this cluster shows that cyberbullying behavior was especially investigated in adolescence. According to the concepts it contains, this cluster was labeled as Social Media in Education.

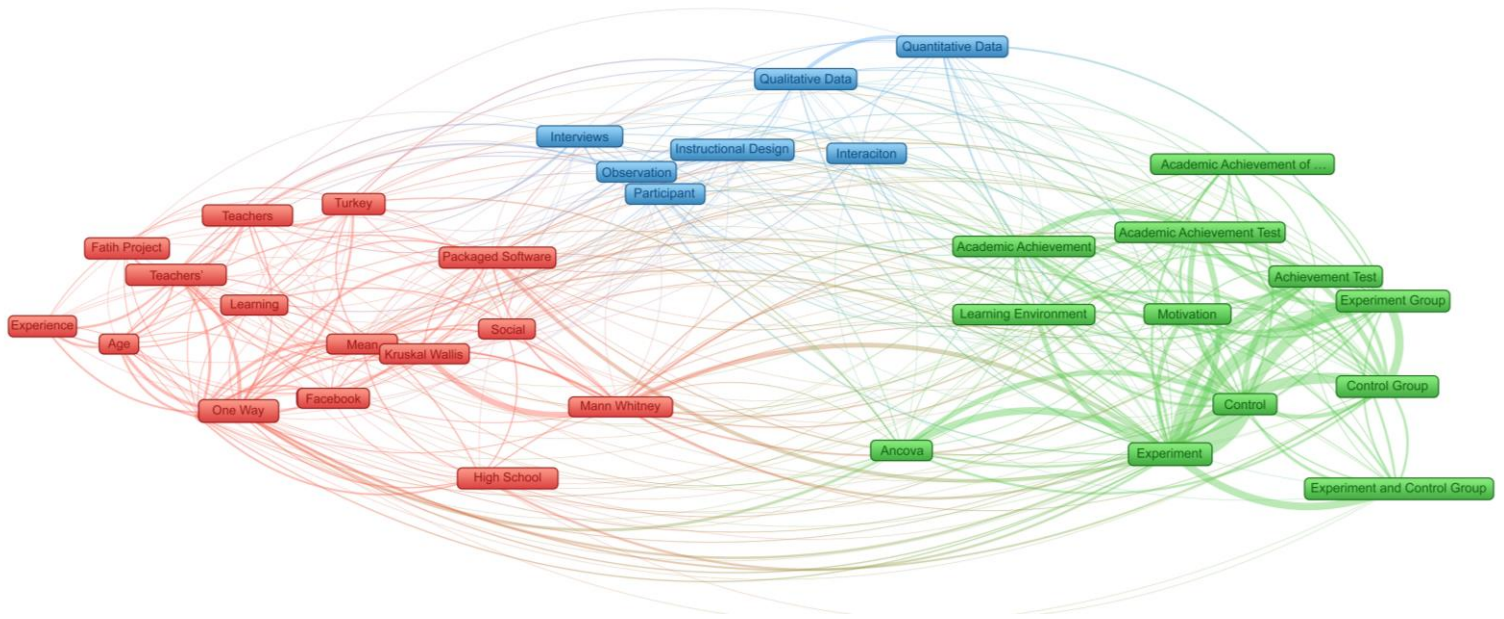


Figure 3. Clusters According to the Abstracts

In the green cluster, teachers, technology usage, Fatih Project, and interactive whiteboard keywords attracted attention. The emergence of elementary schools in this cluster indicated that the theses frequently focused on the teachers working in primary schools and technology integration in these schools. This cluster was labeled as Technology Integration considering the concepts it covers.

The Blue cluster included teaching programming, problem-solving skills, teaching methods, and augmented reality concepts with secondary school students. The inclusion of both university and secondary school students implies that programming education is widely applied in secondary schools and universities in Turkey. Besides, augmented reality studies are conducted with secondary school students. The blue cluster was named Programming Education based on the concepts it encompasses.

The purple cluster consists of teaching English as a foreign language, educational games, and student views. It could be concluded that educational games are frequently used in English language teaching and the studies have qualitative parts, and these parts covered the opinions of students. The purple cluster was labeled as Computer-Supported Language Learning based on the concepts it contains.

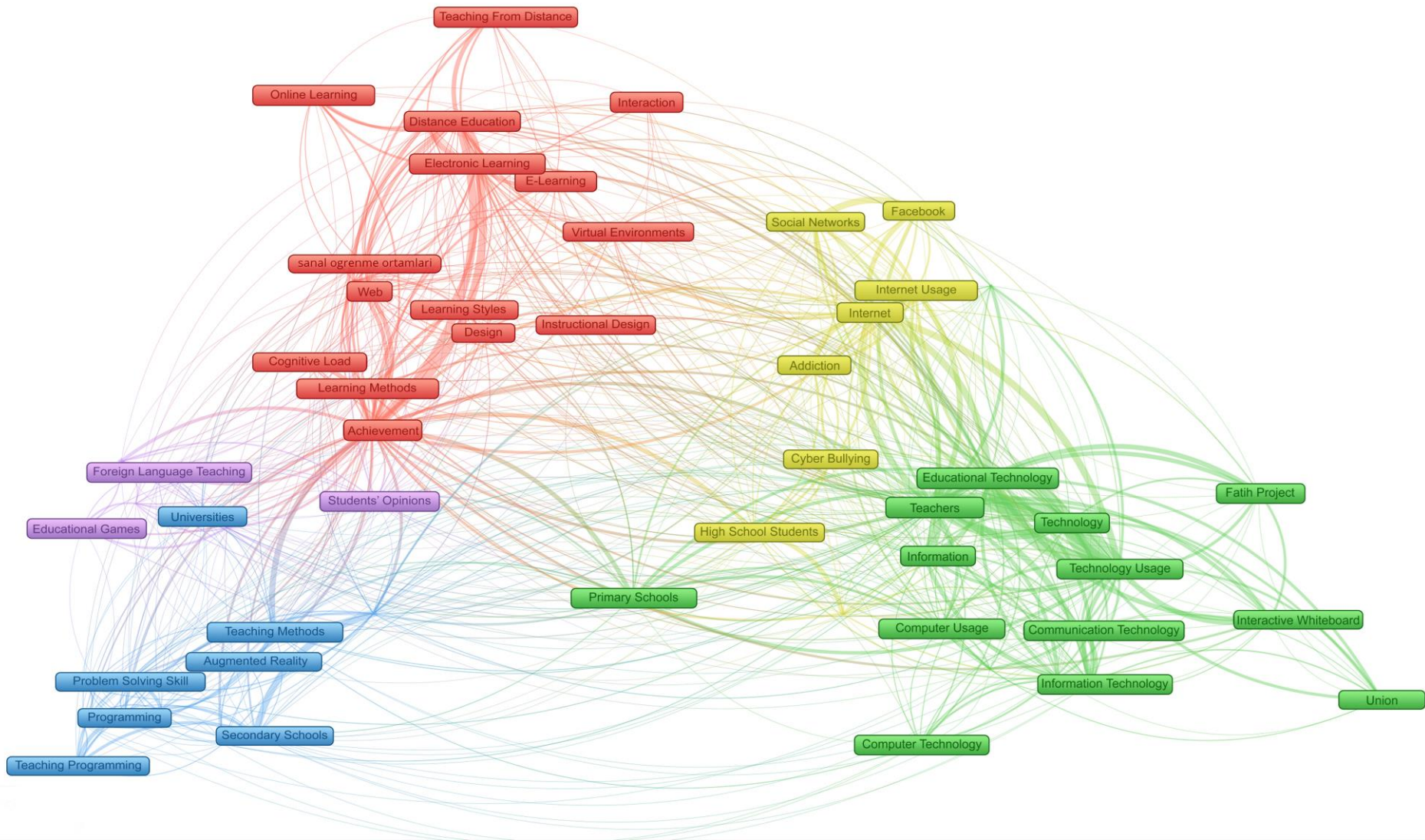


Figure 4. Clusters According to the Keywords

RQ3: What are the trends and patterns in educational technology theses?

The trends of the clusters in the theses are shown in Figure 4. Cluster colors are the same as the ones in Figure 5.

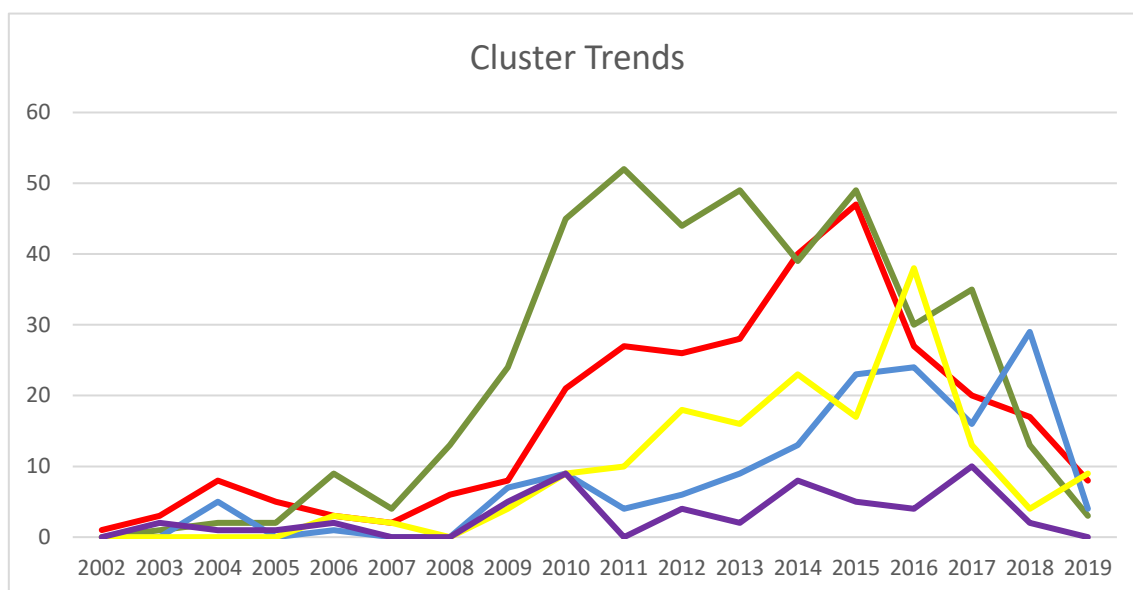


Figure 5. Time Trends of the Clusters

Figure 5 shows that all clusters are in an upward trend as of 2007. Considering that the first students in the field of education technology graduated in 2002, this increase in the clusters seems as a result of this fact. It is observed that the cluster with the highest trend since 2009 is the technology integration cluster. The implementation of the Fatih Project in 2010 led researchers on studying technology integration into education.

In the same years, it is observed that there is an uptrend in the Distance Education cluster. The emergence of the MOOC studies in 2009, with companies such as Udemy and Coursera entering the online education market and the dissemination of online education, has directed the researchers to the field of distance education. However, Distance Education was not observed as a trend as high as technology integration.

The social networks cluster was also observed as a cluster with an upward trend, but not as much as continuous technology integration and distance education. It reached its highest point in 2016. Afterward, it is observed that it began to decline again. The reason for this may be the other clusters whose trend increased after 2016. Researchers may turn to new trend areas and move away from social media studies.

Teaching Programming was also observed as an uptrend cluster. The difference of the programming training cluster from the aforementioned clusters is that the increase in the trend started later than the other clusters. The change in the name of the “Information Technologies” course to “Information Technologies and Software” in 2012 and the addition of programming to the curriculum might cause the trend of the teaching programming set to increase.

The last of the working sets in the field of educational technology was observed as

computer-supported language learning. This cluster is regarded as a cluster that cannot go into an uptrend like other clusters. Although the cluster found itself a place in the field of educational technology, it could not go beyond a certain threshold.

Conclusion

In this study, it is aimed to determine the general trend in the post-graduate studies in the educational technology field in Turkey. The analyses include basic descriptive statistics and text mining methods. The analyses on the keywords and summaries of the studies indicated that three clusters were formed according to the summaries and five different clusters were formed according to the keywords.

The analyses on the postgraduate studies in the field of Educational Technology revealed that most of the studies were carried out in 2015 and 2016. In this case, it is considered that 43 of the 64 departments of CEIT in universities were established between 2007 and 2011 and the increment on the number of students in the relevant date range has an impact.

The findings from the keywords showed that academic achievement is the most studied dependent variable and most of the studies were conducted with the participation of university students. Most of the studies were conducted in the field of distance education. These findings are similar to the previous ones (e.g. Alper & Gulbahar, 2009; Kucuk et al., 2013). It might be concluded that the researchers still have been using a convenience sampling strategy in the studies conducted in the field of educational technology.

Considering that instructional design is an interdisciplinary field of study and an umbrella field (Bodily, Leary, & West, 2019), it can be said that instructional design is applicable in many studies. According to the results of this study, it is seen that instructional design is used mostly in the research studies on distance education. The fact that the researchers did not have sufficient knowledge about the field of instructional design or could not define the field may have caused this. Increasing the number of theoretical and practical courses that will enable students to understand instructional design, especially at the graduate level, may be beneficial. In addition, the system design process in distance education can be described as challenging, and most studies that can be studied at the doctoral level. Therefore, this situation can be interpreted as the more instructional design is done in studies at the doctorate level. From this point of view, it supports the conclusion that instructional design courses are incomplete in graduate programs. However, more in-depth research can be done with qualitative studies to understand this.

Social media, used extensively throughout the world, was used to integrate it into educational environments and it is found out as a cluster in the findings. The intensive use of social media in society brought the problem of cyberbullying with it. Therefore, studies examining the relationship between cyberbullying and social media found a place in the literature (Lowry, Zhang, Wang, & Siponen, 2016; Whittaker, & Kowalski, 2015).

It is also possible to see the effects of the concept of teaching programming and computational thinking, which has gained popularity worldwide in recent years, in the studies. Programming education, which was previously held at the university level in Turkey, started to be implemented in secondary schools in 2012 and it found a place in the curriculum of information technologies. This fact encouraged researchers to study programming education with secondary schools. As a result, secondary school students and programming education were included in the same cluster.

Another concept in the same cluster with secondary school students is Augmented Reality. Considering that augmented reality is a technology that can be used to embody the information (Akçayır & Akçayır, 2017), the reason why it is mostly studied with middle school students might be that they are in a transition period from concrete thinking to the abstract thinking process and the researchers used augmented reality to facilitate the teaching of the abstract concepts. Besides, the participants of this age period have internal motivation for digital games might facilitate the integration of augmented reality technology into secondary schools (Akçayır & Akçayır, 2017).

Recommendations for Future Studies

Based on the findings of the current study, the appearance of instructional design in the red cluster and its divergence from other clusters indicate a key finding in terms of the field. It can be concluded that instructional design is used in the design of distance education environments, but in other clusters, instructional design is not a priority. However, the researchers in this field are expected that instructional design principles should be employed for diverse issues such as teaching programming, language teaching, and the use of social media in learning environments.

The research studies in the field of distance education can be examined deeply to understand at which level they are studied and why instructional design is mostly used in distance education.

Although a downtrend has been observed in the trend of distance education activities after 2015, the COVID-19 outbreak underlined the importance of distance education once again. Therefore, researchers in the field of educational technologies may be recommended to work in the field of distance education.

It is observed that the studies on programming teaching have increased in Turkey as well as all around the world. However, it can be suggested that these studies should be well-planned as theoretical studies, rather than being studied just as they are a popular subject.

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