Blockchain: A Content Analysis of Graduate Theses in Turkey

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Abstract
This study aims to make a descriptive analysis and evaluation of postgraduate theses on blockchain technology conducted in Turkey between 2017 and 2021. Qualitative research methods were used in this research, and theses were analysed with the descriptive content analysis technique. It has been observed that 111 studies have been carried out on blockchain technology and the first thesis was prepared in 2017. 107 graduate studies registered in the Higher Education Council of Turkey's National Thesis Centre database with access permissions were examined. Theses are coded according to publication date, university, institute, department, graduate/ doctorate level, advisors' academic title, thesis language, research method, research sub-areas, city and the region where the thesis was written. Studies on blockchain have been carried out in many universities, and Marmara University is the university that contributes the most to the subject with its graduate studies. Most studies were conducted at the Applied Sciences and Institute for Social Sciences. The distribution of the universities where the thesis studies are conducted according to the geographical regions is examined, the Marmara region leads with 70 studies, and no thesis studies have been carried out in the Eastern Anatolia region. Most of the thesis administrators are faculty members with the title of "Assist. Prof. Dr.". Most of the studies were written in Turkish, and primarily Qualitative Research methods were used. Theses were carried out in 10 institutes and 36 different departments, and most of the theses were produced from the studies in the Business department. The findings of this study will guide other researchers who want to work in the field of blockchain.
Keywords: Blockchain, Descriptive Content Analysis, Graduate Theses, Higher Education, Technology.

1. INTRODUCTION

Blockchain refers to the configuration of an add-only repository of transactions as a list of linked blocks distributed across many machines (Distributed Ledger Technology) (Rauchs et al., 2018). Each block contains a chronologically ordered set of transactions. Cryptographic hashes are used to secure the link from one block to the previous (Xu, Weber, & Staples, 2019). Understanding distributed architectures is a requirement for understanding the blockchain. In a distributed architecture, all stations are interconnected, and at the same time, all are data providers (Holbrook, 2020). Since all stations are servers simultaneously in distributed architectures, the system is more fault-tolerant and more flexible in expansion. Furthermore, since the control is not on specific servers, the most suitable architecture for the peer-to-peer exchange system, which eliminates the middleman, is the distributed architecture. While the distributed part of the Distributed Ledger technology comes from the distributed architecture, the ledger part is inspired by the ledger kept by the accountants, where the information about how much money was transferred between the entities and what the balance was. Each transaction is written on one line and processed according to the balance from the previous transaction. For this reason, if you want to change a transaction in between, you must change the balances of all transactions from that transaction onwards. This ledger is checked and registered periodically; hence, its modification is prevented.

Blockchain offers an architecture that models the distributed working of the ledger (Zheng, Xie, Dai, Chen, & Wang, 2017, June). Each page of transactions is a block, and when each page is completed, it is checked and registered. The rows in the ledger are modelled with the transactions in the blocks. All participants can access the blockchain, that is, the same ledger, and are allowed to validate and register new blocks with the programs they use. So all participants can create new pages in those blocks (Frizzo-Barker, Chow-White, Adams, Mentanko, Ha, & Green, 2020). Since there are many participants in this system, registration is provided by a consensus method. Bitcoin uses proof of work consensus. In this method, with the agreement of more than 50% of the participants, the block is registered and added to the chain. Different consensus methods have also been developed over time.

Another consensus method that should be mentioned is the proof of stake method. In this method, an amount of cryptocurrency is pledged. A certain number of controllers are appointed, taking into account the number of block transactions to be registered and the amount pledged, and upon their agreement, the block is registered.

In Blockchain structure, separate blocks form a chain by embedding the cryptographic summary of the previous block to be linked together like the pages of a ledger. A one-way function is used to obtain the cryptographic digest of the previous block. It converts the entered data into text of a specific size, regardless of the length or content of the data. Since it is one-way, the original content cannot be accessed from the translated text. For example, Bitcoin uses the SHA-256 cryptographic hash function. This function always produces a 256-bit cryptographic hash regardless of the length of initial data.

Szabo was the person who coined the term "Smart Contract" for the first time in 1994, which he defined as a "computerised transaction protocol fulfilling the terms of a contract" (Szabo, 1997). However, this idea, which found an application area with the spread of blockchain, has also been the element that carried the blockchain to the second stage (Swan, 2015). Smart contracts have all the features of blockchain. Smart contracts, like legal contracts, are signed between parties, but this signature is a cryptographic signature. In case of disagreement in legal contracts, a legal authority decides on a solution. In contrast, no other authority is needed in smart contracts because the rules written in computer code are automatically implemented in the blockchain environment. The prepared smart contract is added to a block on the blockchain platform. Therefore, smart contracts can be considered computer programs running on the blockchain. Smart contracts have found many uses, such as identity management and access control, real estate, internet of things (IoT), telecommunications, logistics, e-government/law, financial applications, health applications (Hewa, Ylianttila, & Liyanage, 2021), and education applications (Alammary, Alhazmi, Almasri, & Gillani, 2019; Tekgüç, Adalıer, & Yurtkan, 2020) are at the forefront of these areas.

Featured Blockchain based applications are classified as follows in the literature: Educational applications (Bedi, Gole, Dhiman, & Gupta, 2020; Tekgüç & Adalıer, 2021; Bdiwi, De Runz, Faiz, & Cherif, 2017; Spearpoint, 2017; Bore, Karumba, Mutahi, Darnell, Wayua, & Weldemariam, 2017, November), financial applications (Casino, Dasaklis, & Patsakis, 2019; Haferkorn & Quintana Diaz, 2014, December), business and industrial applications (Tapscott & Tapscott, 2017; Kshetri, 2018; Kogure, Kamakura, Shima, & Kubo, 2017), health management (Zhao, Zhang, Peng, & Xu, 2017, March; Mamoshina, et al., 2018), travel and tourism (Özgit & Adalıer, 2022; Calvaresi, Leis, Dubovitskaya, Schegg, & Schumacher, 2019), integrity verification (Bhowmik & Feng, 2017, August; Dupont, 2017), administrative management (Reijers, O'Brolcháin, & Haynes, 2016; Hou, 2017, July), internet of things (Adler, Berryhill, Veneris, Poulos, Veira, & Kastania, 2018, July; Lin, Shen, & Miao, 2017, July), privacy and security (Dorri, Steger, Kanhere, & Jurdak, 2017; Chanson, Bogner, Wortmann, & Fleisch, 2017, September), data management (Asharaf & Adarsh, 2017; Zhang, 2016).

Featured blockchain platforms are Bitcoin (Nakamoto, 2008), Ethereum (Buterin, 2020; Mohanty, 2018), EOS (EOS, 2021), Hyperledger Fabric (Hyperledger Fabric, 2021), Corda R3 (Corda R3, 2021), Ripple (Ripple, 2021), Quorum (Chase, 2021), and NEO (NEO, 2021).

This study aimed to investigate academic work at the graduate level that has been done on the Blockchain between 2017 and 2021 in Turkey. A total of 107 master's and doctoral theses were analysed, and the findings are presented in this paper. It provides descriptive information about the nature of the studies and offers recommendations for future studies on Blockchain.

2. METHOD

2.1 Design of the Study

This is a descriptive study that includes a systematic review of the research on Blockchain in Turkey. The data in this study were collected through document analysis, one of the qualitative research methods, and descriptive analyses of the reached theses were made. Document review includes analysing written materials containing information about the case or cases to be investigated. Descriptive analysis is a type of qualitative research. With descriptive analysis, data is collected with keywords determined using many data collection methods. The collected data is divided into specific themes and organised (Gökal, Cantemir, & Adalıer, (2021). The primary purpose of descriptive analysis is to make it an understandable and easy summary for the readers. The researcher reads, organises and digitises the data according to the previously created themes (Dawson, 2019).

2.2 Research Questions

This study addresses the following research questions:

1. How many theses have been written on Blockchain in the years 2017-2021 in Turkey?
2. How many theses have been written on Blockchain in various universities in Turkey?
3. How many theses have been written on Blockchain in various institutes in Turkey?
4. How many theses have been written on Blockchain in various departments of the universities in Turkey?
5. How many master's and doctorate degrees are there on Blockchain?
6. What are the academic titles of the supervisors who have supervised theses on Blockchain?
7. How many theses on Blockchain have been written in Turkish and English?
8. What are the research methodologies that researchers working on Blockchain followed?
9. How many sub-areas have been involved in research on Blockchain?
10. How many theses on Blockchain have been written in each city of Turkey?
11. How many theses on Blockchain have been written in each region of Turkey?

2.3 Population and Sampling

The population consists of theses and dissertations accessible from the YÖK (Higher Education Council of Turkey) National Thesis Centre database. The first dissertation on Blockchain was published in 2017. Therefore, the study's time frame was determined from 2017 to 2021 to include all published theses accessible from the centre on Blockchain. Purposive sampling was used as a sampling strategy. Of the 107 theses, 98 were master's theses, and 9 were doctoral dissertations.

The universe of this study is the YÖK National Thesis Centre database. The study sample consisted of masters and doctoral theses in the field of blockchain between the years 2017-2021. There was no thesis on this subject before 2017. Criteria for the determination of theses; Theses prepared between 2017-2021 that are registered in the YÖK National Thesis Centre database. These theses are the ones that can be accessed from the YÖK National Thesis Centre database. Theses within the scope of the research were collected in September 2021. The keywords "blokzinciri" and "blockchain" has been searched in the YÖK national thesis centre database. Thus, 111 theses registered to the National Thesis Center were reached within the scope of the research, of which only 107 are open to access.

2.4 Data Collection Procedure

During the data collection procedure, the keywords for the blockchain were entered in Turkish as "blokzinciri" and in English as "blockchain" in the search engine and were downloaded between 01 and 30 September 2021 by the researchers. 111 theses were located in the database, and 107 were open to access. Four theses out of the initially available 111 were eliminated from the study because their full texts were not accessible due to the access limits placed by their authors. The remaining 107 theses with access permission were included in the study. Out of 107 theses, 98 were masters' theses, and 9 were doctoral dissertations. Figure 1 shows the data collection procedure visually.

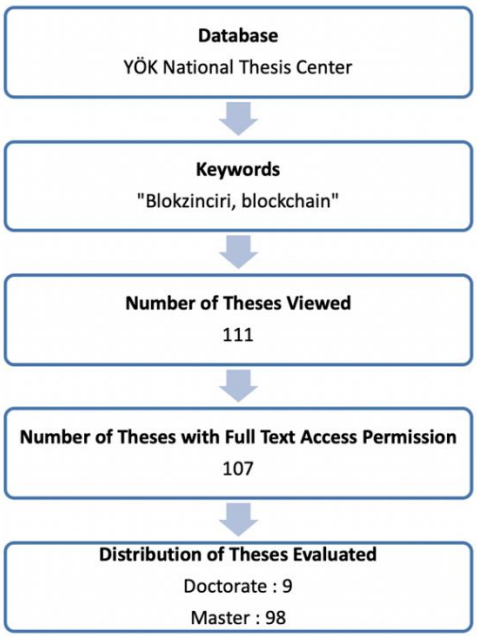

Figure 1. Data collection procedure

2.5 Data Analysis

Descriptive content analysis is used in this study. The theses were downloaded in PDF document format. The unit of analysis was identified as descriptive information regarding the nature of the graduate theses on Blockchain. Each thesis was assigned numbers starting from 1 to 107. The abstracts and full texts of 107 theses were read and analysed thoroughly. Eleven codes for the analysis were identified. The codes are as follows: the year, the university, the institute, the department, the graduate/doctorate level, the supervisors' academic title, language, research methodology, research sub-area, the city and the region where the thesis was written. Then, the frequency of each code was counted. The information on the frequency of the codes enabled the researchers to compare them.

3. FINDINGS

In this part of the study, the postgraduate theses on “blokzinciri” and “blockchain” between the years 2017-2021 were presented in figures according to the year, university, institute, department, graduate/doctorate level, supervisors' academic title, language, research methodology, research sub-area, city and the region where the study conducted.

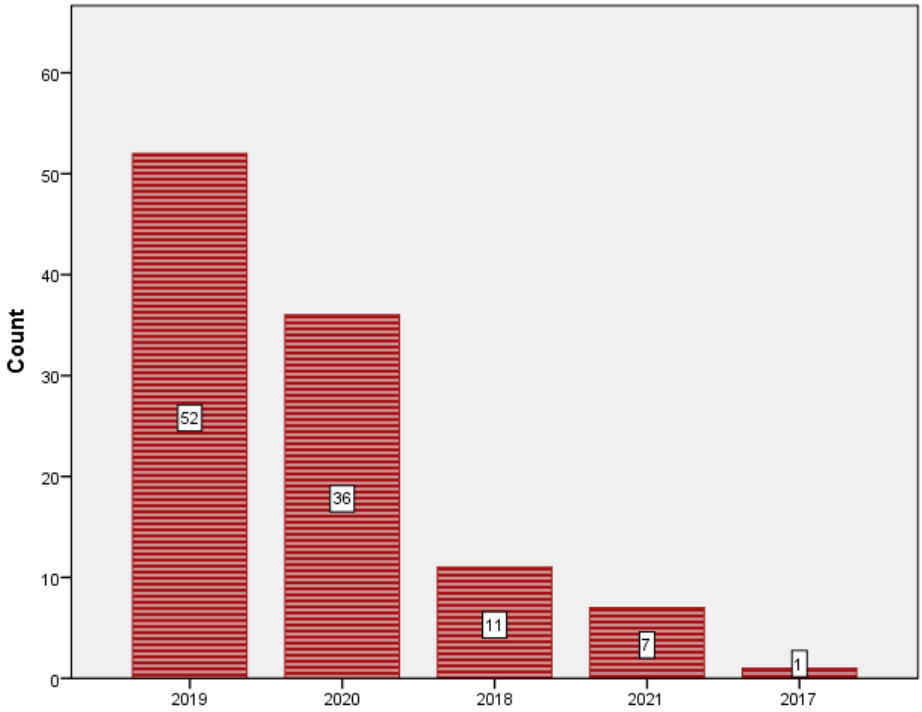

Figure 2. Graduate Theses According to Years

After the first and only study in 2017, blockchain studies on thesis subjects continued and became popular in the following years. The year with the most studies is 2019, with 52, which constituted 48.60% of the total studies, followed by 36 (33.64%) studies in 2020 and 11 (10.28%) studies in 2018. When Figure 2 is examined, there is a significant increase in the number of theses published since 2017, with the least number constituting 6.54% (7) of the total studies in 2021.

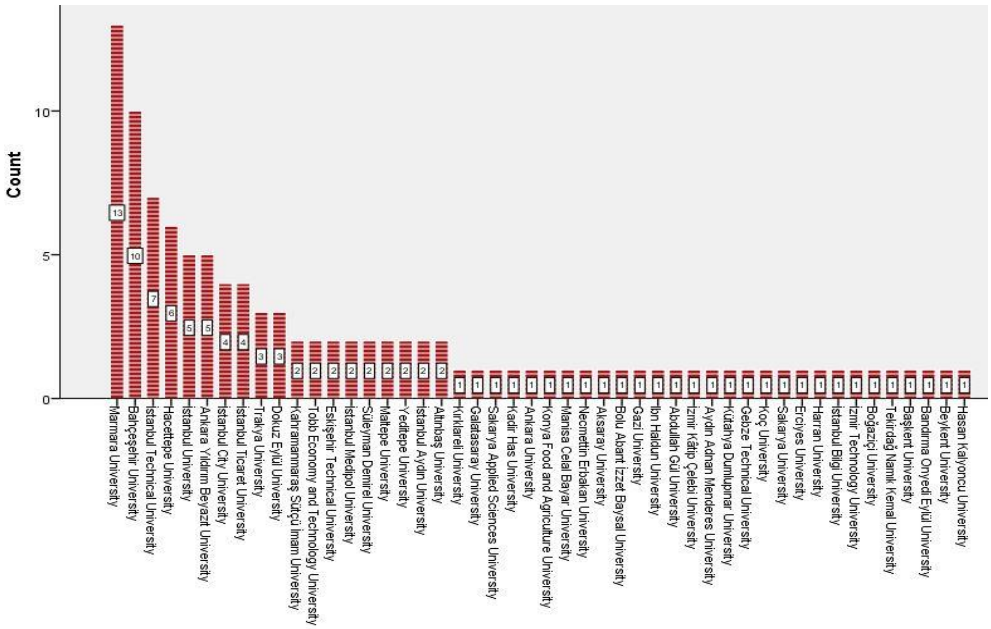

Figure 3. Graduate Theses According to Universities

As seen in Figure 3, A total of 107 thesis studies were carried out in 49 different universities. Marmara University is ranked as the university with the highest number of studies on the Blockchain, with 13 (12.15%). Bahçeşehir University followed with 10 (9.35%) studies, and Istanbul Technical University was in third place with seven thesis studies (6.54%).

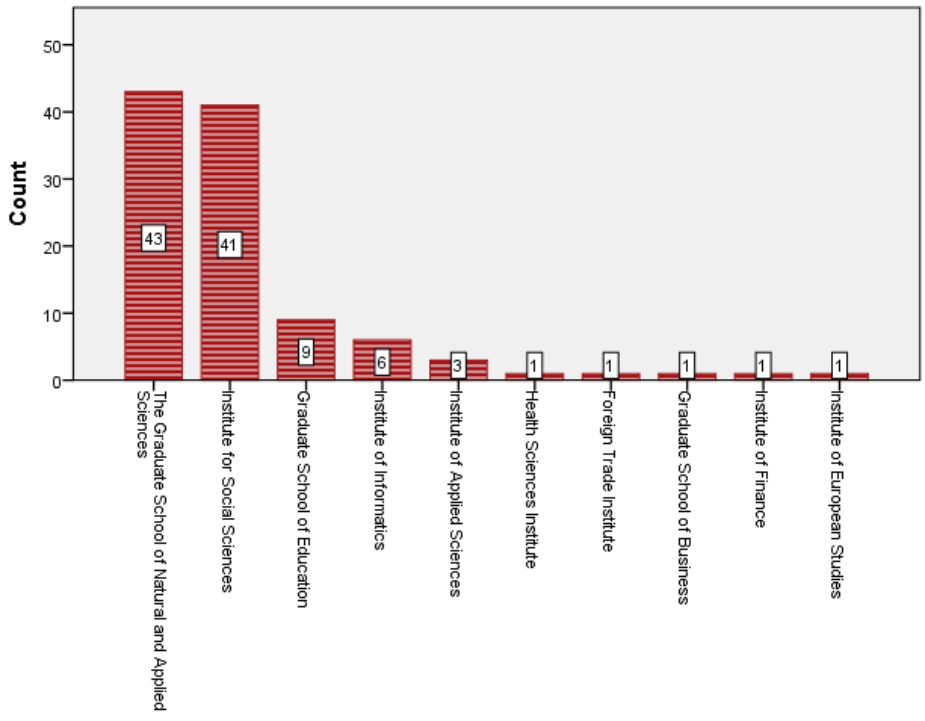

Figure 4. Graduate Theses According to Institutes

According to the distribution of institutes in Figure 4, studies were conducted under ten institutes. The Graduate School of Natural and Applied Sciences is where most studies are carried out, with 43 (40.19%). Following with 41 (38.32%) thesis studies, the Institute for Social Sciences carried out the second-highest number of studies. It has been observed that the Institute for Social Sciences and the Graduate School of Natural and Applied Sciences carried out almost the same number of studies. Then the Graduate School of Education with 9 (8.41%) theses, the Institute of Informatics with 6 (5.61%) theses, and the Institute of Applied Sciences with 3 (2.80%) theses. Health

Sciences Institute, Foreign Trade Institute, Graduate School of Business, Institute of Finance and Institute of European Studies each carried out 1 (0.93%) thesis.

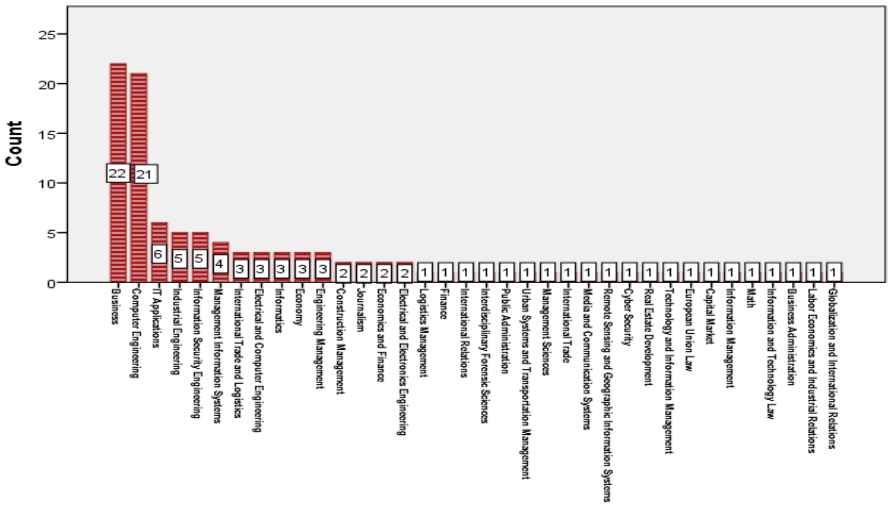

Figure 5. Graduate Theses Written According to Departments

Figure 5 shows graduate theses written about Blockchain in 36 different departments. The Department of Business has the most studies with 22 (20.56%) thesis. The Computer Engineering department follows with 21 (19.63%) studies as the department closest to the department of Business without any significant difference. Next follows IT Applications 6 (5.61%), Information Security and Industrial Engineering, each with 5 (4.67%), Management Information Systems 4 (3.74%), International Trade and Logistics, Electrical and Computer Engineering, Informatics, Economy and Engineering Management, each with 3 (2.80%). Four departments with two studies each, and 21 departments with only one study. As a result, we can say that a broad spectrum of disciplines and departments are interested in blockchain.

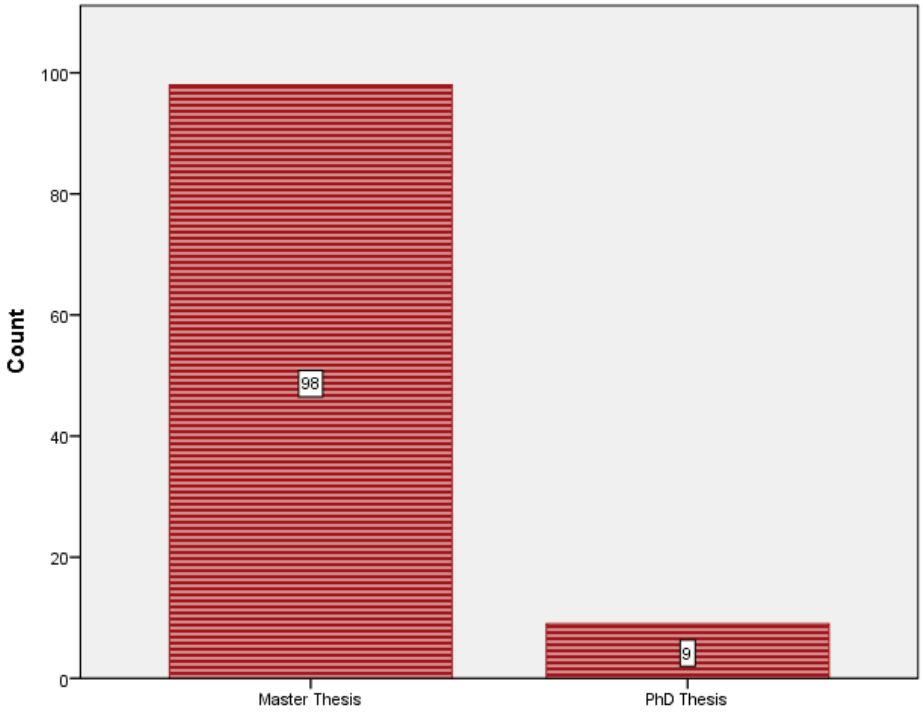

Figure 6. Graduate Theses According to Degree Levels

When Figure 6 is examined, it is seen that most master's theses were prepared with 98 (91,59%) studies consisting of master's theses. Master's theses were followed by doctoral studies with 9 (8.41%). The majority of the research was composed of master's theses.

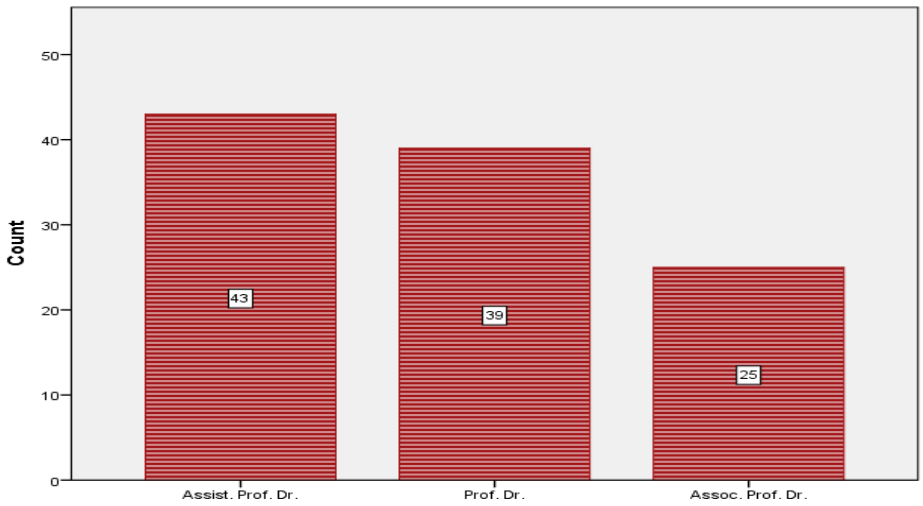

Figure 7. Graduate Theses According to Advisors' Academic Title

When Figure 7 is examined, it is seen that 43 (40.19%) studies were supervised by "Assist. Prof. Dr." followed by 39 (36.45%) thesis studies by "Prof. Dr." titled faculty members. For the following 25 (23.36%) theses, faculty members with the title "Assoc. Prof. Dr." supervised the thesis.

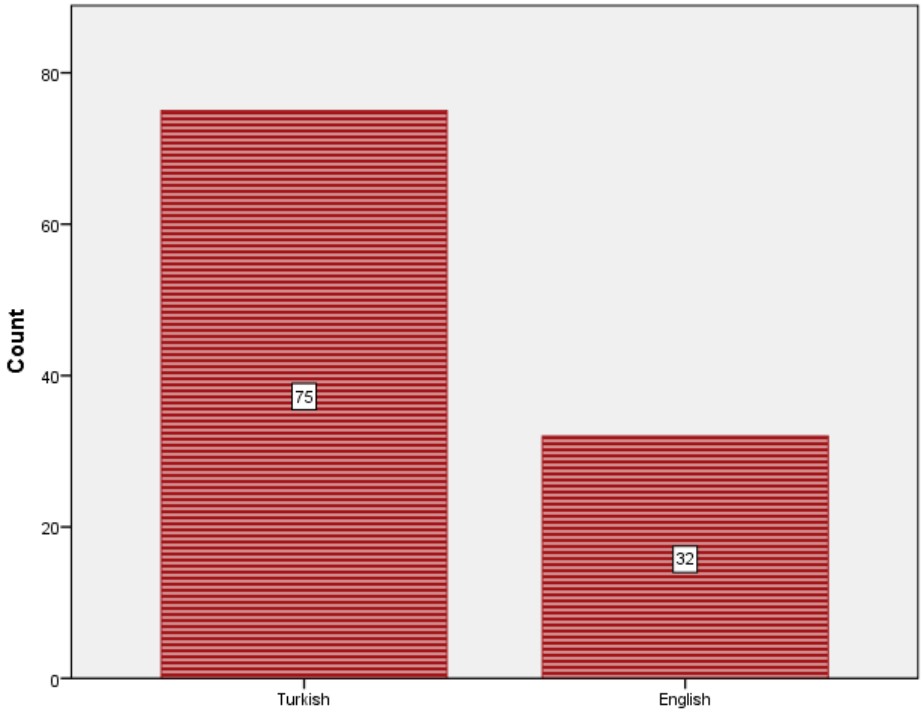

Figure 8. Graduate Theses According to Language

When Figure 8 is examined, it is seen that most of the theses were prepared in Turkish, with 75 (70.09%) thesis studies and 32 (29.91%) studies conducted in English. According to this result, although the thesis studies in Turkish seem more, there are also significant numbers of studies in English.

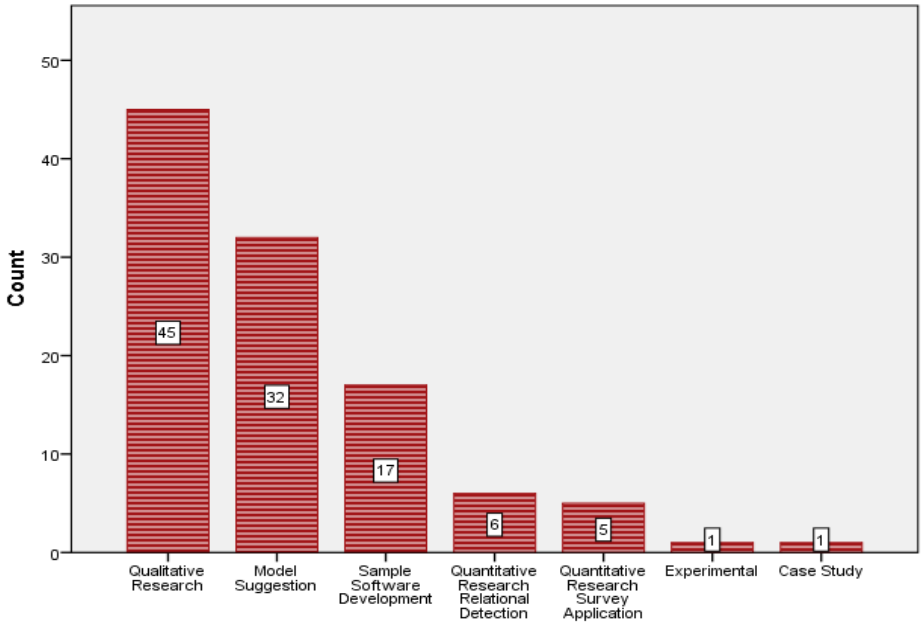

Figure 9. Graduate Theses According to Research Methodology

When compared by the research methodology, as seen in Figure 9, seven different methods were used in a total of 107 thesis studies. The qualitative research method constitutes 42.06% with 45 theses. 32 (29.91%) studies were carried out using the Model Suggestion method, 17 (15.89%) studies with Sample Software Development, 6 (5.61%) with Quantitative Research Relational Detection, 5 (4.67%) with Quantitative Research Survey Application, Experimental and Case Study methods were conducted only once (0.93%).

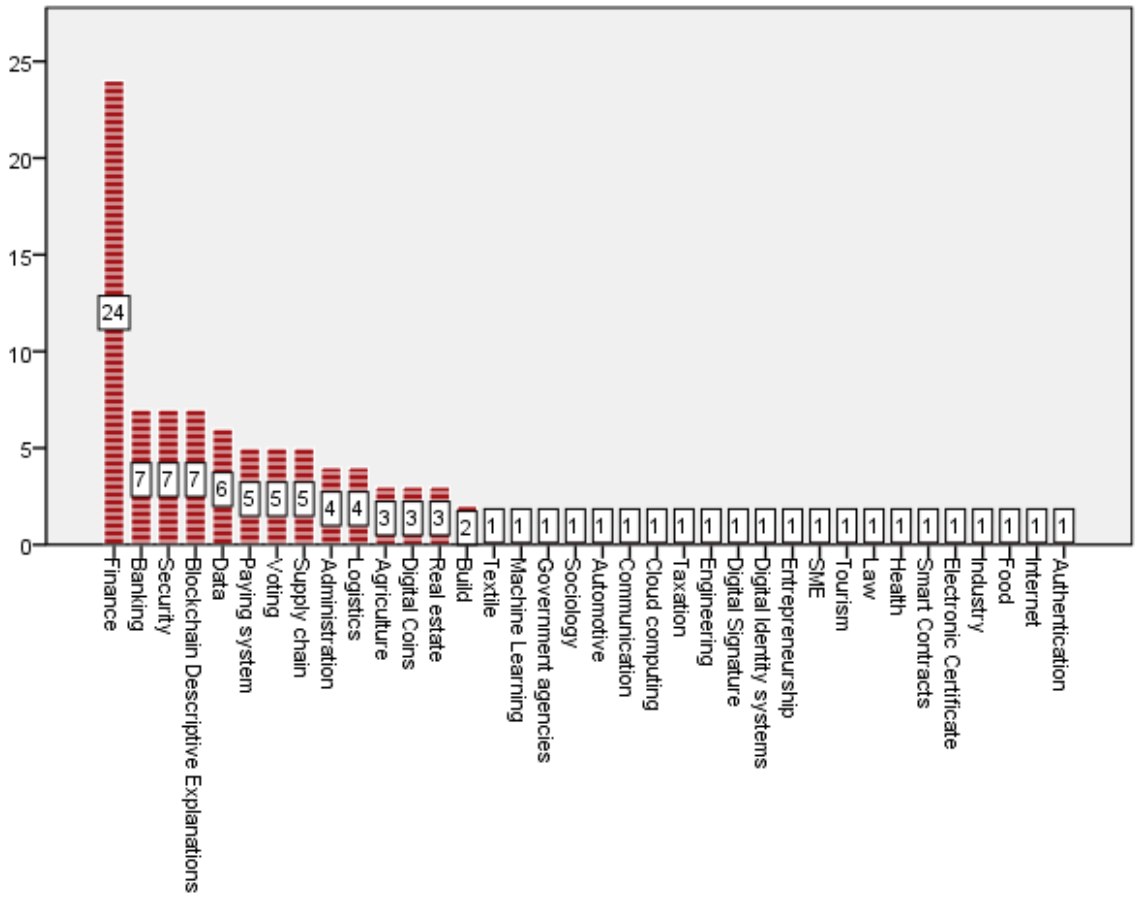

Figure 10. Graduate Theses According to Research Sub-area

Figure 10 shows areas of research in 36 different fields. As can be seen, most research was carried out in Finance, with 24 (22.43%) theses. The second place is shared between Banking, Security, and Blockchain Descriptive Explanations, with 7 (6.54%) thesis each. Six studies have been done in Data, with 22 fields contributing only 1 study each.

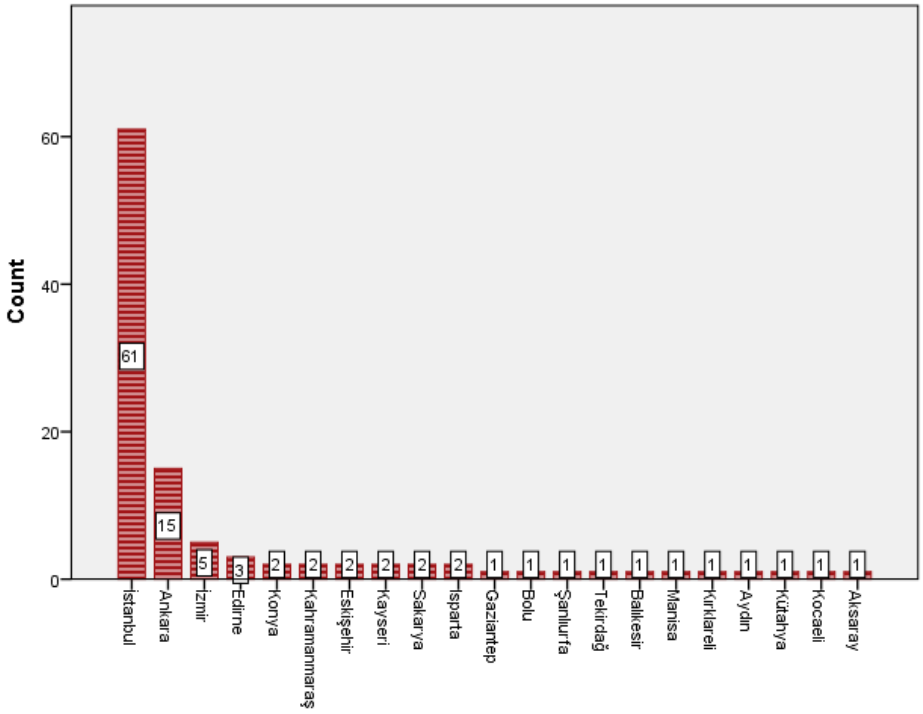

Figure 11. Graduate Theses According to Cities in Turkey

As can be seen in Figure 11, a total of 107 theses were carried out in 21 different cities. İstanbul covers more than half of all studies, with 61 (57.01%) according to the City where the research was conducted. Ankara follows with 15 (14.02%), then İzmir with 5 (4.67%), and Edirne with 3 (2.80%). Konya, Kahramanmaraş, Eskişehir, Kayseri, Sakarya and Isparta contributed with two each. The remaining 11 cities only contributed with one thesis each.

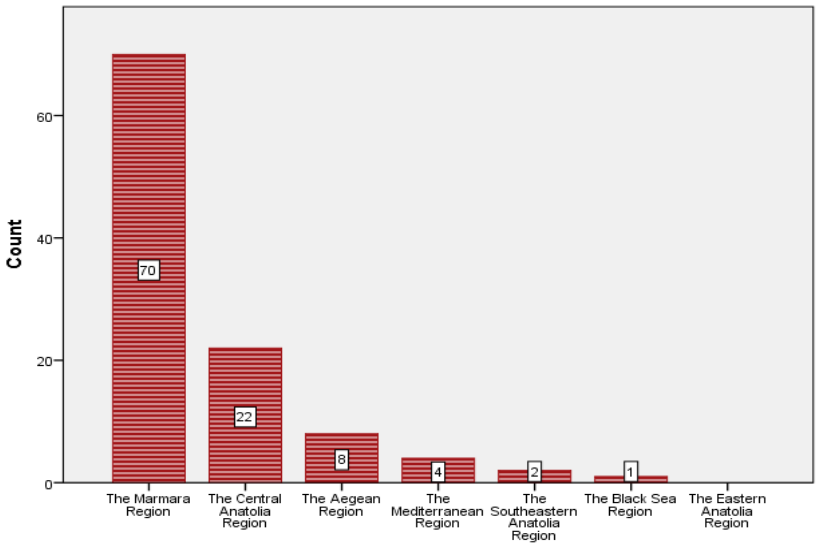

Figure 12. Graduate Theses According to Regions of Turkey

As can be seen in Figure 12, thesis studies were carried out in 6 out of 7 regions of Turkey. The Marmara region covers more than half of all thesis studies, with 70 (65.42%). The Central Anatolia region follows with 22

(20.56%). The Aegean region with 8 (7.48%), the Mediterranean region with 4 (3.74%), South East Anatolia region 2 (1.87%), Black Sea 1 (% 0.93) and no studies have been conducted in the Eastern Anatolia region.

4. DISCUSSION AND CONCLUSION

The popularity of blockchain studies as thesis subjects increased after the publication of the first and only study in 2017 in Turkey. There are 11 studies published in 2018, 52 in 2019 and 36 in 2020, and seven in 2021. A total of 107 thesis studies were carried out in 49 different universities. Marmara University is ranked as the university with the most (13) studies on Blockchain. Bahçeşehir University followed with ten, and Istanbul Technical University was in third place with seven thesis studies. Among all the universities, Istanbul universities take the lead with 61 thesis studies. Therefore, it is concluded that blockchain technology is a subject of more interest among researchers in Istanbul universities. Looking at the distribution of the studies among ten institutes, The Graduate School of Natural and Applied Sciences is where most (43) of the studies on the Blockchain are carried out. Following with 41, Institute for Social Sciences has the second highest number of studies, even though those two institutes are on opposite ends of the academic spectrum. Together, those two institutes created the majority of the studies. The Department of Business has the most studies with 22 theses. The Computer Engineering department follows with 21 studies and is the closest to the Department of Business. The remaining departments have studies below six each. According to the results, we can say that many disciplines and departments are interested in Blockchain, although the number of studies needs to be increased. The majority of the studies were Master's thesis, with 98.

On the other hand, doctoral thesis studies with only 9 followed Master's theses. It has been observed that there is a significant gap in the number of doctoral dissertations and Master's thesis studies; hence PhD students can be encouraged to study Blockchain-related research more. According to the titles of thesis advisors, 43 studies were supervised by “Assist. Prof. Dr.” and 39 thesis studies by “Prof. Dr.” titled faculty members. Almost two-thirds of the studies are written in Turkish, totalling 75. On the other hand, 32 studies were conducted in English. According to this result, the thesis studies are mainly in Turkish. Therefore, more studies in English must be encouraged. Concerning the research model, seven different methods were used in a total of 107 thesis studies. The Qualitative Research method leads with the 45 studies. While 32 studies were carried out using the Model Suggestion method, 17 studies in Sample Software Development, 6 Quantitative Research Relational Detection, 5 Quantitative Research Survey Application, and Experimental and Case Study methods were conducted only once. All thesis span 36 fields of research, with most research carried out in finance with 24 theses. The second place is shared between banking, security, and blockchain descriptive explanations with seven theses each. Six studies have been done in Data, with 22 fields contributing only 1 study each. When these fields are compared with the recent featured blockchain-based applications mentioned in the literature, it is seen that more studies need to be done in these fields. Also, it has been seen that there is no study in the education field. Blockchain has potential in the field of education, and there are many kinds of research opportunities in the areas of scalability, privacy and security, cost, trust, setting boundaries, immutability, immaturity, lack of sufficient data and weakening the traditional school concept, which are the challenges to be overcome in practice.

Thesis studies were carried out in 21 cities, İstanbul dominating with 61 alone. Ankara follows with 15, İzmir 5, and Edirne with 3. The remaining 11 cities only contributed one thesis each. The number of studies must be increased in those cities. According to the geographical regions, thesis studies were carried out in 6 out of 7 regions of Turkey. The Marmara region covers more than half of all thesis studies, with 70. The Central Anatolia region follows with 22, then the Aegean region with eight, the Mediterranean region with 4, South East Anatolia region with two and the Black Sea region with only one. The Eastern Anatolia region has not contributed at all. Therefore, it is concluded that Western regions are more interested in Blockchain, and Eastern regions can be involved with the topic more.

Future research can concentrate on the studies published in internationally indexed journals. Comparisons concerning the methodology, field of studies, and contributions might be analysed. Postgraduate students can be encouraged to review Blockchain studies in different countries and write comparative studies. Such studies can contribute to both practitioners and decision-makers. Moreover, the research scope can be expanded by examining the articles on the subject at the national and international levels. More studies can be written jointly by various disciplines. Doctoral dissertations about Blockchain technology must be encouraged. The English language used for blockchain thesis research can be promoted more. Blockchain, which has started to be used in many areas worldwide, attracts attention and finds an increasing place of usage. The new developments in the world have led all companies and countries to concentrate more on blockchain technology as the main driving force of the developments and to achieve competitive advantage. For this reason, it is crucial to increase the number of postgraduate studies in Turkey by diversifying research topics in the fields such as tourism, transportation, higher education, and service industries is necessary.

4.1 Limitations

This study is limited to postgraduate studies, which could be accessed with full-text permission from the YÖK national thesis centre database that was written between 2017-2021, and has one of the keywords "blokzinciri" and "blockchain". Thus, the results of this study are generalisable within the context of Turkey.

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