Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi
Cilt 17, Sayı 1, Haziran 2023, sayfa 120-173. ISSN: 1307-6086
Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education
Vol. 17, Issue 1, June 2023, pp. 120-173. ISSN: 1307-6086

Research Article

An Investigation of Theses and Dissertations About the Statistics and Probability Learning Area in Turkey*

Ayşe YALDIZ [1], Nadide YILMAZ [2]

[1] Başarı College, Karaman/Turkey, ayse.gokcayir@hotmail.com, http://orcid.org/0000-0003-4580-2691

[2] Karamanoğlu Mehmetbey University, Faculty of Education, Department of Mathematics Education, Karaman/Turkey, nadideylmz70@gmail.com, http://orcid.org/0000-0003-1624-5902

Received : 25.01.2023 Accepted : 02.06.2023

https://doi.org/10.17522/balikesirnef.1242577

Abstract – A document analysis was used in this study to examine Turkish theses/dissertations on probability and statistics.126 graduate theses/dissertations were analyzed by subjecting them to both content and descriptive analysis. According to the findings, theses/dissertations were not distributed evenly by publication year. The majority of theses/dissertations were written in the learning area of statistics. There was a great deal of interest in the keyword "probability". Most of the theses/dissertations examined how teaching practices affected the development of components. A large amount of research was conducted using quantitative methods. Most of the students in the study were middle schoolers, with the sample group ranging from 0 to 100 people at most. There was greater use of technology-supported teaching environments than other teaching environments. Both students and teachers exhibited misconceptions and a lack of knowledge regarding statistics and probability. Because of the teaching practices that were fulfilled, students' performance increased significantly.

Key words: thesis, dissertation, document analysis, statistics and probability.

Corresponding author: Nadide YILMAZ, Karamanoğlu Mehmetbey University.

Introduction

In today's world, rapid changes in information have paved the way for new needs to emerge. It is imperative that research be conducted to train the manpower necessary to meet these needs (Kayhan & Özgün-Koca, 2004). Therefore, questioning educational research is

* This study was created from the master thesis by the first author under the supervision of the second author

crucial (Özkaral & Mentiş-Taş, 2017). As an example of these research areas, math education is one that we use every day in all aspects of our lives, and whose importance is becoming increasingly apparent as time goes on. Various fields (such as industry, art, and technology) have evolved through mathematics, and mathematics plays a vital role in making sense of life (Hardy, 2004) because in this changing world, individuals who are competent in mathematics, will have more opportunities in the future (National Council of Teachers of Mathematics [NCTM], 2000). Mathematics education has incorporated all this awareness into the curriculum, and students are learning the knowledge and skills they need. Probability and statistics are two areas of knowledge and skills that should be acquired by students (NCTM, 2000). Despite the ease of accessing information, it has become more difficult to accurately describe and interpret information, and reading and interpreting data has become even more important (Shaughnessy, 2007). Both statistics and probability are based on randomness and deal with events that cannot be predicted with certainty in daily life (Ader, 2018), which explains the connection between them. In today's data-rich world, individuals must be able to evaluate concepts and results related to statistics and probability to correctly interpret situations and make accurate decisions (Bargagliotti et al., 2020; Franklin et al., 2005; 2007; Gal, 2002; Garfield & Ben-Zvi, 2008; NCTM, 2000; Watson, 2006; Wild et al., 2018). Statistics and probability knowledge and skills are required to acquire this evaluation skill during the educational process (Watson, 2006). It is therefore necessary to emphasize statistics and probability education at all levels of education (Garfield & Ben-Zvi, 2008; NCTM, 2000).

Turkey has prioritized the acquisition of knowledge and skills in the learning area of statistics and probability with increasing importance since 1926. As part of the 2005 curriculum, greater emphasis was given to this learning area to achieve objectives similar to those in other countries' curricula (Ader, 2016; 2018). Aside from all these changes, it has also become a matter of interest what work has been done in this field. Consequently, graduate studies, which serve an important purpose in this regard, must be examined because the field of graduate studies contains information researched by researchers and educators (Jin, 2004). Thus, the examination of theses/dissertations is of importance in this context. Furthermore, graduate studies play an important role in constructing the country's education system (Sevinç, 2001).

There are some studies that examine the trend of studies focusing on probability and statistics aiming to reveal trends in general statistics and probability research (e.g., Bakker et

al., 2018; Kayaly, 2013; Tishkovskaya & Lancaster, 2010; Zamora Araya et al., 2021). A number of studies have examined how students perform in the field of statistics and probability (Aziz & Rosli, 2021; Judi & Sahari, 2013; Sotos et al., 2007). Several studies (e.g., Zieffler et al., 2008) have attempted to reveal trends in studies on how statistics is taught and learned at universities. Becker (1996) revealed that less than 30% of the literature reviewed is constituted by experimental studies, contrary to Garfield and Ahlgren (1988) who stated there are limited studies that help students understand statistics and probability. Inference is a concept that students have profound and common misconceptions about, as shown by Sotos et al. (2007). Probability studies go beyond statistical studies, according to Garfield and Ben-Zvi (2007). Furthermore, the studies conducted with primary and secondary school students mainly covered concepts related to data, distribution, centre, variability, and probability. According to Zieffler et al. (2008), university students displayed inconsistencies in reasoning about sampling distributions, measures of central tendency, and dispersion. Studies exploring the development of students' statistical reasoning are more common than studies focusing on other statistical concepts, according to van der Merwe and Wilkinson (2011). Among the studies examined, only 15% focused on information and communication technologies. The fact that there have been very few studies that examine noncognitive factors and course design is also remarkable. According to Zieffler et al. (2011), variability is the most frequently used keyword. The Statistics Education Research Journal also published research studies on teachers and textbooks, although students are the most frequently studied participants. As listed by Judi and Sahari (2013), computer-assisted cooperative learning, problem-based learning, and active learning are the methods used in student-centered statistics education. Furthermore, the experimental method was the most commonly used, followed by the questionnaire and case study. According to Aziz and Rosli (2021), who analyzed 36 articles examining statistical literacy skills among students, four dominant factors influence statistical literacy development. They listed these factors as learning environment, students' attitudes, teaching method, and students' knowledge. Zamora Araya et al. (2021), on the other hand, bibliometrically analyzed the studies on teaching statistics indexed in the Scopus and Ebsco database between 2010 and 2019. The data were analyzed in five main categories: statistical sense, use of technology, attitude towards statistics, teacher knowledge, and active learning. The results showed that there is a need to improve statistical literacy, reasoning, and thinking in the classroom through activities using technology, active learning, and the teacher's statistical knowledge. In addition, attention was drawn to the importance of

discipline and pedagogical insight in helping students develop positive attitudes towards statistics.

According to the studies examining the trend in mathematics education research in our country, statistics and probability are the least studied subject areas (Çiltaş et al., 2012; İncikabı et al., 2017; Ulutaş & Ubuz, 2008; Yücedağ & Erdoğan, 2011). The number of studies analyzing the trends in the area of statistics and probability (Dinç, 2021; Tosun & Özen-Ünal, 2019) is quite limited. The word "graph" was used most frequently in statistics and probability articles and theses, according to Tosun and Ünal (2019). Studies with experimental designs were more prevalent than those with qualitative methods. Most of the studies were conducted with 50-100 participants and most of the data were collected using achievement tests, knowledge tests, and development tests. Studies focused primarily on the effectiveness of teaching methods and analyzed the obtained data with quantitative methods. In addition, middle school students have the most difficulty with line graphs. From 2005 to 2020, Dinç (2021) examined master's theses and doctoral dissertations carried out with middle school students in Turkey in the learning area of statistics and probability. According to the results obtained, Middle East Technical University produced most of the theses/dissertations. Additionally, more theses/dissertations were prepared in 2019 than in previous years. Additionally, the number of 8th graders participating in the probability theses/dissertations was more and the number of participants was concentrated between 31 and 100. As a result, data collection methods such as scales were used extensively, and quantitative methods were preferred. Another remarkable finding was the large number of achievement measurement studies conducted.

The worldwide importance of statistics and probability has increased considerably due to the widespread use of quantitative information in all fields (Wild et al., 2018). Being able to read this information accurately, present reliable and convincing evidence-based arguments and critically evaluate data-based inferences are important skills that all citizens of the 21st century must possess (Leavy et al, 2018). This situation has made the teaching of statistics and probability even more important in the teaching process (Bargagliotti et al., 2020; Franklin et al., 2005; 2007; Gal, 2002; Watson, 2006). Parallel to this importance, it has been observed that the research on the related subject area has significantly increased (Zieffler et al., 2011). It can be said that postgraduate studies are of great importance at this point because postgraduate studies contain information researched by researchers and educators working in this field (Jin, 2004). In this sense, it can be said that the examination of theses is important

because postgraduate theses have a very important task in terms of revealing the developments in the field and showing the direction of future research. Moreover, graduate studies are factors decisive in shaping the education system of the country (Sevinç,2001; Tarman et al., 2010). All these show the necessity of analyzing the studies to determine how the importance of probability and statistics has increased in Turkey as in the world and what kind of trends are adopted in these studies. The purpose of this paper is to present an overview of the studies done in our country on statistics and probability education. This study, in an attempt to contribute to the literature, examines theses/dissertations created in the learning area of statistics and probability holistically, handles them in different dimensions, and evaluates them to reveal their current status in our country. Educators, teachers, and researchers who work in this field may find useful clues by revealing the trend of theses/dissertations conducted during the process. In addition to guiding future studies and practices, it can also influence future research policies (Ulutaş & Ubuz, 2008; Sevencan, 2019; Suri & Clarke, 2009). This study is especially important given the very limited number of studies showing trends in the teaching and learning of statistics and probability in our country (e.g., Dinç, 2021; Tosun & Özen-Ünal, 2019). This study may also have a potential effect on increasing awareness about statistics and probability as a learning area and contribute to the field. This study can also support researchers specializing in the subject by providing a perspective to those who will do research on this subject, determining which areas need to be further researched and guiding the applications to be made. Thus, researchers can contribute to the literature by choosing an original research topic and concentrating on the points that need to be studied (Rhoades, 2011). Furthermore, curriculum experts can revise curricula based on the results. This study aimed to examine trends displayed in master's theses and doctoral dissertations in the learning areas of statistics and probability and seek answers to the following questions:

What is the distribution of the,

1. types (master’s or doctoral) of the theses/dissertations?
2. years of publication of the theses/dissertations?
3. universities where the theses/dissertations created?
4. genders of the authors of the theses/dissertations?
5. languages used in the theses/dissertations?
6. subjects of the theses/dissertations?
7. keywords used in the theses/dissertations?

8. purposes of the theses/dissertations?
9. research methods used in the theses/dissertations?
10. participants/samples of the theses/dissertations?
11. sample sizes of the theses/dissertations?
12. data collection tools used in the theses/dissertations?
13. data analysis methods of the theses/dissertations?
14. teaching practices used in the theses/dissertations?
15. results obtained in the theses/dissertations?

Methodology

Research Design

A qualitative research method was used in the current study to examine the master's theses and doctoral dissertations in the field of statistics and probability in detail and to understand the results. Document analysis was employed as one of the qualitative research methods. Document analysis allows examining documents obtained in various ways for a systematic purpose and interpreting the results obtained (Corbin & Strauss, 2008; Wach, 2013). The current study conducted a document search in consideration of the study's purpose, analyzed the obtained documents in accordance with the established criteria, and interpreted the results (Figure 1).

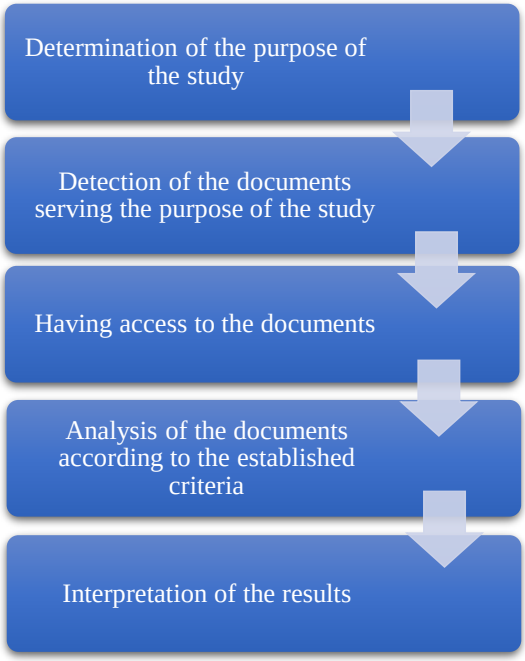

Figure 1 Research process

Data Sources and Data Collection Tools

The purposive sampling method was employed while determining the data sources of the study. This method allows the researcher to choose a rich source of data about the problem focused on (Fraenkel & Wallen, 2006). In accordance with the research problem, criterion sampling was used, which is one type of purposive sampling. Since the purpose of the current study was to examine the theses/dissertations prepared in the learning area of statistics and probability in Turkey, the theses/dissertations open to access in the National Thesis Centre [NTC] were searched. The following are the criteria that guided the selection of theses/dissertations:

- being written in the field of mathematics education,
- being related to the learning areas of statistics and/or probability,
- being completed in the period between 2000 and 2021,
- having open access.

In this context, it was determined that there were theses/dissertations in the NTC that did not use these words as keywords, although they were written in the learning areas of statistics and/or probability. Accordingly, the keywords were further customized and the search was conducted by using the keywords such as “graphs”, “measures of central tendency”, “measures of dispersion”, “variability”, “probabilistic thinking” related to these learning areas. Our search resulted in 126 graduate theses/dissertations (108 master's theses, and 18 doctoral dissertations) carried out between 2000 and 2021.

Through documents, which are an important source of data in qualitative research, written materials that contain information about the phenomena being researched by the study are analyzed (Yıldırım & Şimşek, 2011). In the current study, since it was aimed to analyze the theses/dissertations carried out in the learning area of statistics and probability, documents were used and a thesis review form was created for the criteria to be examined (App-1). These criteria included the name of the thesis/dissertation, the author and the advisor, the type of the thesis/dissertation and the year of publication, the university where the study was conducted, the language of the thesis/dissertation, the gender of the authors, the subject of the study, the list of the keywords, the purpose of the theses/dissertations, the research method, the sample (participants), the sample size, the measurement tools, the data analysis techniques, the results of the theses/dissertations, and the teaching practices used in the theses/dissertations. As a result, an Excel file was created for each thesis/dissertation after being analyzed according to these criteria.

Data Analysis

In order to analyze the data, the qualitative data analysis method was employed, and the data were subjected to both content analysis and descriptive analysis (Yıldırım & Şimşek, 2011). The first step was to create a file for each thesis/dissertation. As a result, each thesis/dissertation was evaluated using the questions outlined in App-1. Identifiers were assigned to each thesis/dissertation, such as T1, T2,... Descriptive analyses were performed on thesis/dissertation type, year, keywords, subject, method, sample (participants), sample size, measurement tools, and analysis techniques used. Codes were used to calculate the frequencies and percentages within the categories previously created. The findings were interpreted based on the tables and graphs created based on the data obtained. A content analysis was conducted on the theses/dissertations to determine their purposes, results, and teaching practices. Data from each research problem was analyzed to create codes. Similar codes were then used to create themes. In light of these themes and codes, the results and comments were presented.

Reliability and Validity of the Study

In order to establish the validity and reliability in qualitative research, credibility, transferability, internal reliability or dependability, and confirmability criteria should be met (Lincoln & Guba, 1985). For these criteria to be met, it was first explained why the purposive sampling method had been selected. Furthermore, the criteria for selecting which studies to include were explained. A detailed explanation of the research method, data collection tool, data collection processes, and data analysis was provided. Moreover, after the thesis review form was developed to analyze the theses/dissertations, it was sent to the expert reviewers for their feedback, before being finalized. The process of determining categories in data analysis is another crucial issue. Reliability is also ensured by this factor. The data were coded by both researchers and their compatibility was examined. The compatibility between these evaluations; that is, the reliability of the study, was calculated using the following formula proposed by Miles and Huberman; Reliability = Agreement / (Agreement + Disagreement) (Miles & Huberman, 1994). The current study was found to have an 85% reliability based on this formula. It indicates that a study is reliable when it exceeds 70% (Miles & Huberman, 1994). Additionally, controversial issues were discussed until a consensus was reached.

Researcher Role

Researchers who use a qualitative research approach play an important role from beginning to end in their research. The role of the researchers is extremely important for the healthy conduct of the whole process, starting with the determination of the research problem to the collection, analysis, and interpretation of the data (Fraenkel & Wallen, 2006; Gall et al., 2007). Researchers conducted the current study to be as objective as possible. By keeping their assumptions and prejudices separate, the researchers kept the information objective. They only included their own views during the interpretation stage after analyzing the collected data. Controlled inquiries were conducted on the subject being studied during the data collection stage. The collected data were checked again after they had been processed. By digitizing the data with frequency and percentage values, the data were interpreted. Furthermore, expert opinions contributed to objectivity.

Findings and Interpretation

This section provides information on the type of theses/dissertations analyzed, the year of publication, the university where they were written, the gender of their authors, the subjects, keywords used in the theses/dissertations, as well as their purposes, research methods, participants (samples), sample sizes, data collection tools, data analysis methods, teaching practices, and results. Figure 2 shows the distribution of theses by type of thesis/dissertation.

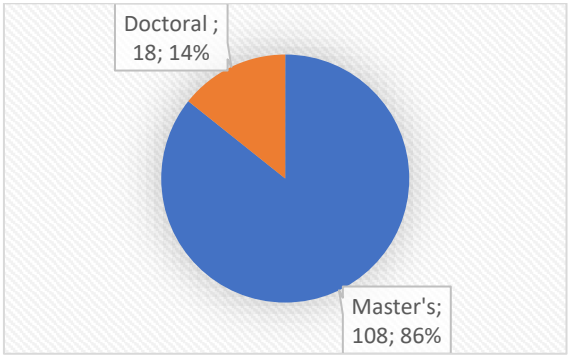

Figure 2 Distribution of the theses/dissertations by type

As seen from the distribution of 126 theses, 108 master's theses and 18 doctoral dissertations were prepared. Most of these theses were master's theses, while 14% were doctoral dissertations. Accordingly, master's theses account for the majority of theses/dissertations prepared. Figure 3 shows the results of the examination of theses based on their publication years.

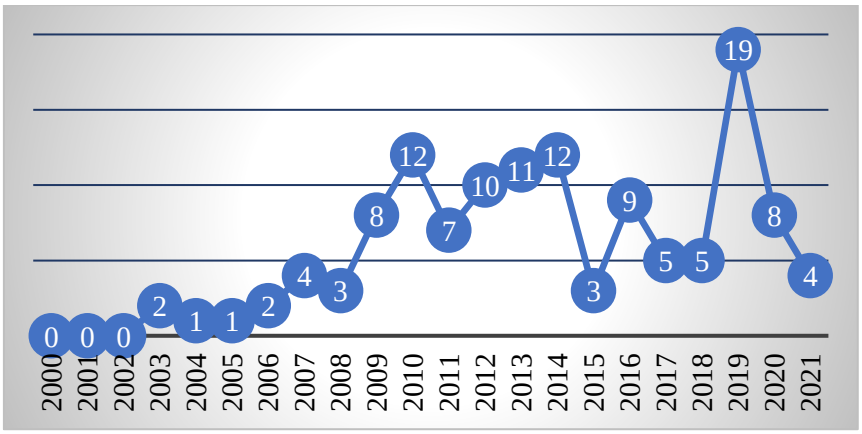

Figure 3 Distribution of theses/dissertations by year of publication

According to Figure 3, no theses/dissertations were prepared in this field between 2000 and 2002 based on the distribution of theses/dissertations across the years. Since the first studies in this field began in 2003, there has been an increase until 2010. Even though the number of theses/dissertations written in this field decreased in 2011, a significant increase was observed until 2014. In contrast, a significant decrease was observed in 2015, and a significant increase was noticed in the following years, especially in 2019. Despite the fact that this field had theses/dissertations in 2020 and 2021, they were fewer than in 2019. 2019 was the year with the highest number of theses/dissertations written. Furthermore, Figure 4 shows the distribution of master's theses and doctoral dissertations over the years.

Figure 4 Distribution of the theses/dissertations by year and type

According to Figure 4, master's theses show fluctuations over time. Doctoral dissertation fluctuation levels are lower than those of master's theses. A study of which universities the theses/dissertations were written led to the creation of Figure 5.

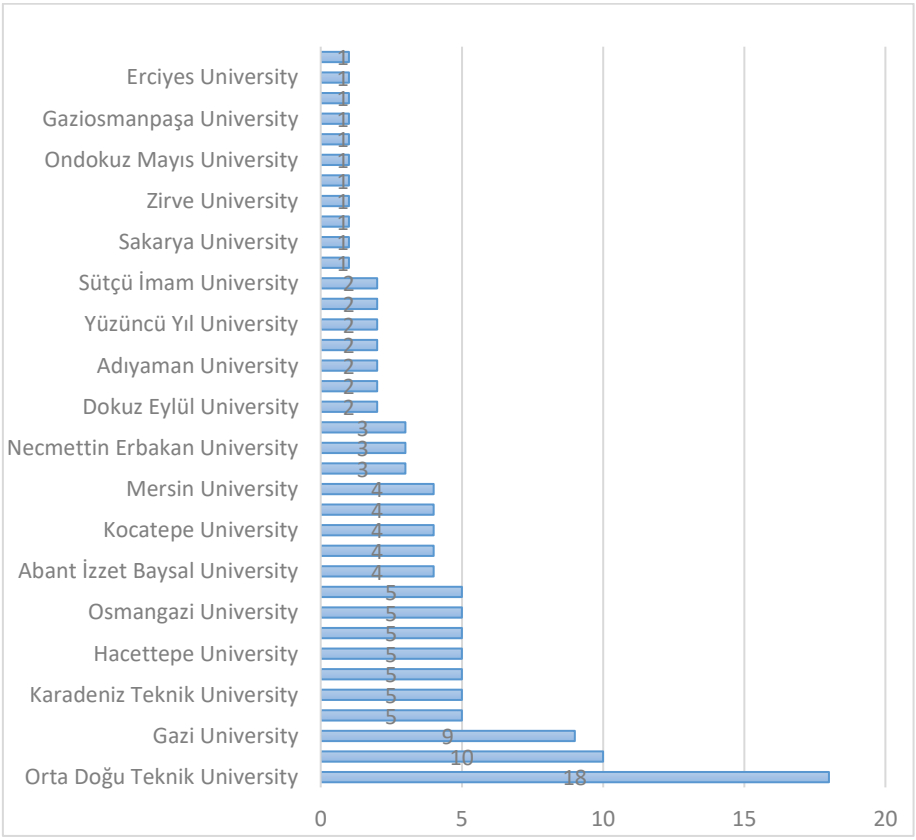

Figure 5 Distribution of the theses/dissertations by university

Middle East Technical University published the most theses/dissertations on statistics and probability, with 18 theses/dissertations, followed by Marmara University with 10 theses/dissertations, and Gazi University with 9 theses/dissertations. A total of five theses were published by seven universities, and four theses were written by five universities. Based on the genders of the authors of the theses/dissertations, it was found that approximately six out of ten theses/dissertations prepared in the learning area of probability and statistics were written by females (Figure 6).

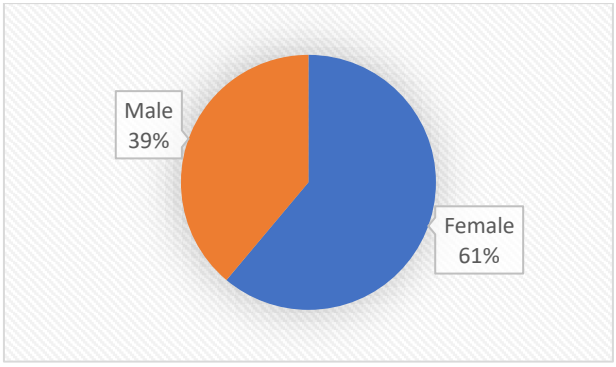

Figure 6 Distribution of the theses/dissertations by gender

When the language used in the theses/dissertations was examined, it was revealed that 80% of the theses/dissertations were written in Turkish and 20% were written in English (Figure 7).

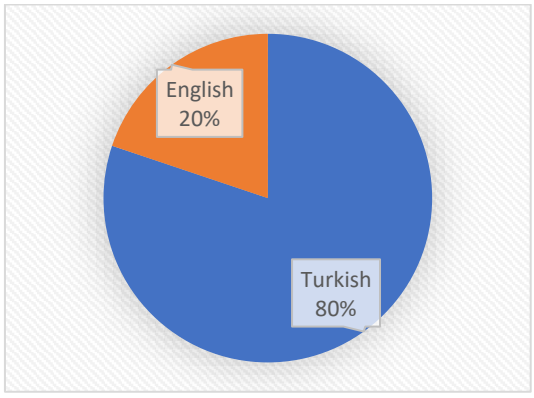

Figure 7 Distribution of the theses/dissertations by language

The distribution of the examined theses/dissertations according to their subjects is shown in Figure 8.

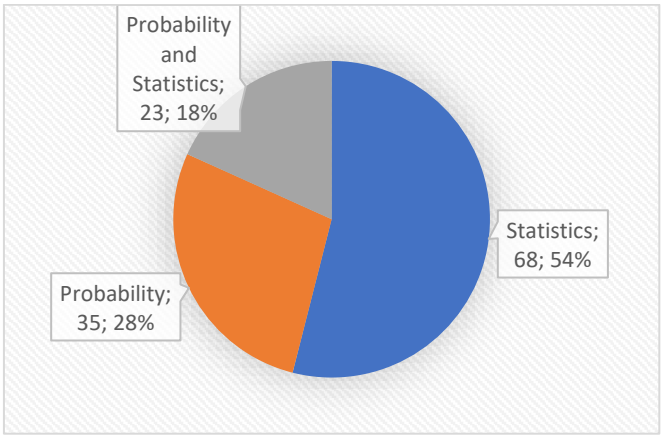

Figure 8 Distribution of the theses/dissertations by subject

Based on Figure 8, approximately half (54%) of the theses/dissertations were written in the field of statistics, followed by theses/dissertations on probability (28%). The theses/dissertations written in both statistical and probability fields account for about one-fifth (18%) of the theses/dissertations. Table 1 summarizes the keyword distribution in theses/dissertations. There are three or fewer keywords that are less frequently used, and these are listed in Table 1.

Table 1 Distribution of the Theses/Dissertations by Keyword

Keywords	Frequency (n)	Percentage (%)
Probability	28	6%
Teacher	18	4%
Attitude	18	4%
Statistics education	18	4%
Mathematics education	14	3%
Achievement	14	3%
Misconception	13	2.8%
Statistical literacy	11	2.4%
Mathematics teaching	10	2.2%
Graph	8	1.7%
Academic achievement	7	1.5%
Statistics	7	1.5%
Computer-assisted teaching	7	1.5%
Pre-service mathematics teachers	7	1.5%
Realistic mathematics education	6	1.3%
Primary school	5	1.1%
Probability and statistics	5	1.1%
Grade level	5	1.1%
Cooperative learning	5	1.1%
Constructivist learning	5	1.1%
Gender	4	0.9%
Tinkerplots	4	0.9%
Anxiety	4	0.9%
Middle school mathematics teachers	4	0.9%
Traditional teaching method	4	0.9%
Other	221	49.6%

According to an evaluation of the keywords used in the dissertations, the word "probability" was the most frequently used. Despite the fact that most of the theses/dissertations were written in the field of statistics, it is noteworthy that the most common keyword used in theses is “probability”, followed by “teacher”, “attitude”, “statistics education”, “mathematics education” and “achievement”. A total of 49.6% of the keywords were used three or fewer times.

Table 2 shows the distribution of the examined theses/dissertations by their purposes. In some theses/dissertations, there was more than one purpose, so this was taken into account in the coding process. Table 2 indicates that a significant number of theses/dissertations have been written with the purpose of investigating “the effect of teaching practices prepared to

make students gain knowledge and skills related to statistics and probability on the development of different components". Almost one-third of the theses/dissertations were prepared for this purpose (37%). Approximately one-fourth of all theses (25%) examined students' knowledge and misconceptions of statistics and probability. 16 percent of theses/dissertations examined the knowledge of statistics and probability of teachers/pre-service teachers. There were 6% of theses/dissertations that examined the relationships between statistical and probability concepts and other variables (e.g., gender). A total of 4% of the theses/dissertations were conducted to improve pre-service teachers' understanding of statistical and probability concepts. 3 percent of theses/dissertations were devoted to "developing a scale for measuring knowledge and skills related to statistics and probability (e.g., statistical literacy)" or "modelling the relationships between concepts and situations associated with statistics and probability (e.g., statistical anxiety)". Only 2% of all theses/dissertations examined curriculum/textbook/theses and revealed teachers' and students' views on statistics and probability-related situations (portfolio, dynamic geometry software). One percent of the theses/dissertations aimed at revealing teachers'/pre-service teachers' statistical awareness. According to the evaluation of the purposes of the theses/dissertations, most of the theses/dissertations were aimed at making students gain knowledge and skills related to statistics through teaching practice. There are then theses/dissertations designed to explore teachers' and students' knowledge of statistics and probability, as well as their misconceptions about them. Three out of every four theses/dissertations (79%) were structured around these three purposes. In general, the dissertations' purposes can be interpreted as consistent with the keywords. Among the components listed for the purpose of "investigating the effects of teaching practices designed to teach students statistics and probability on different components" are achievement and attitude. Accordingly, it is not surprising that the keywords related to this situation such as attitude, achievement, and academic achievement are used too often in theses/dissertations prepared for this purpose. Students' knowledge/misconceptions about statistics and probability are examined in theses aiming to examine students' knowledge/misconceptions. "Misconception" is used more often than many other keywords to achieve this goal. A fifth of all theses/dissertations focus on teachers or pre-service teachers, so it is not surprising that the word "teacher" is used excessively.

Table 2 Distribution of the theses/dissertations by purpose

Purpose	Thesis Identifier	Frequency	Percentage
Studies examining students' knowledge/misconceptions about the concepts of statistics and probability	T1, T5, T14, T17, T18, T24, T27, T29, T30, T33, T35, T36, T40, T42, T46, T62, T63, T64, T72, T73, T77, T80, T82, T92, T101, T103, T104, T105, T109, T113, T119, T120, T121, T122, T123, T124	36	26%
Studies examining the effects of teaching practices prepared to make students gain knowledge and skills related to the concepts of statistics and probability on the development of different components (e.g., achievement, attitude)	T2, T3, T4, T6, T9, T10, T11, T12, T15, T16, T20, T22, T23, T25, T26, T28, T32, T34, T38, T39, T41, T44, T45, T46, T48, T49, T52, T53, T54, T55, T58, T60, T65, T66, T67, T71, T75, T78, T79, T83, T85, T88, T91, T96, T97, T98, T105, T106, T107, T110, T115, T120	52	37%
Scale development studies on knowledge and skills related to statistics and probability (e.g., statistical literacy)	T7, T19, T43, T59	4	3%
Studies examining the relationships between different concepts of statistics and probability, and different variables (e.g., gender)	T8, T21, T29, T42, T69, T74, T80, T100, T104	9	6%
Studies revealing teacher and student views on statistics and probability-related situations (portfolio, dynamic geometry software)	T13, T89, T110	3	2%
Studies revealing the knowledge of teachers/pre-service teachers about the concepts of statistics and probability	T31, T51, T56, T57, T59, T70, T74, T76, T81, T84, T86, T93, T94, T95, T102, T111, T112, T114, T116, T117, T118, T126	22	16%
Studies aiming to improve teachers/pre-service teachers' knowledge of the concepts of statistics and probability	T31, T81, T90, T111, T116, T117	6	4%
Studies revealing the statistical awareness of teachers/pre-service teachers	T68, T87	2	1%
Studies that model relationships between the concepts/situations of statistics and probability (e.g., statistical anxiety)	T37, T47, T61, T99	4	3%
Studies examining curricula/textbooks/theses	T50, T108, T125	3	2%

The research methods employed by the theses/dissertations prepared in the learning area of statistics and probability were examined and are presented in Figure 9.

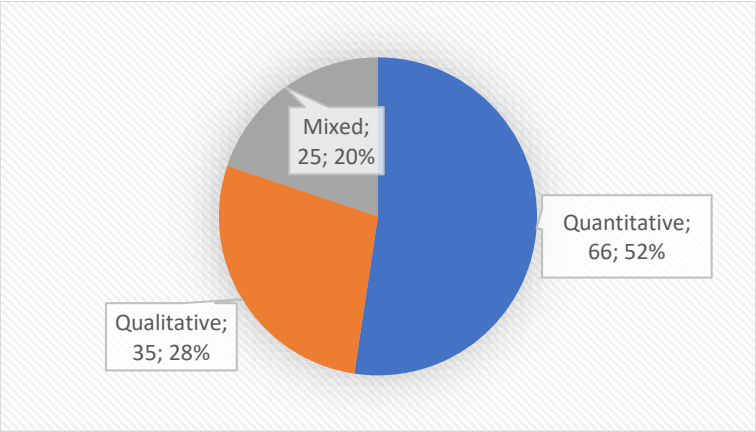

Figure 9 Distribution of the theses/dissertations by research method

Approximately half (52%) of the theses/dissertations used the quantitative research method. A qualitative research method was used in 28% of the dissertations. Twenty percent of theses/dissertations used a mixed research method. Hence, quantitative research is more commonly used to prepare dissertations. Figure 10 illustrates the distribution of quantitative research methods in dissertations.

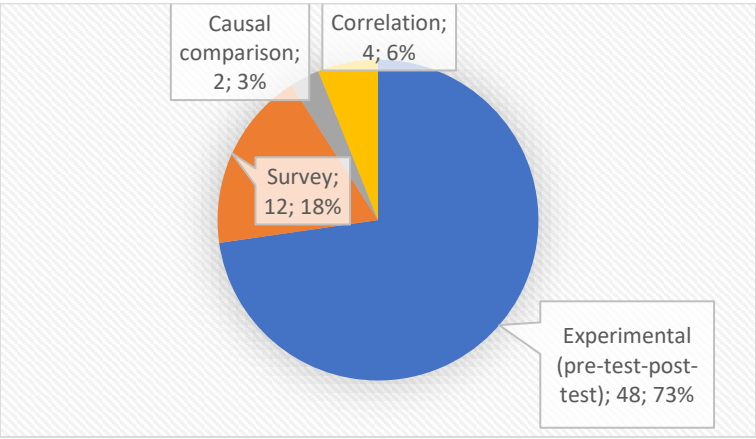

Figure 10 Distribution of the theses/dissertations by quantitative research method

According to Figure 10, the most commonly used quantitative method is the experimental method (48-73%), followed by the survey method (12-18%). A correlation method was used in four theses (4-6%), and a causal comparative method was used in two theses (2-3%). There is a higher number of experimental studies in dissertations, which is consistent with their objectives. It is not surprising that the majority of theses/dissertations (37%) prefer the experimental method since four out of ten theses/dissertations (37%) are about teaching practices designed to help students develop knowledge and skills in statistics

and probability concepts. Figure 11 displays the distribution of qualitative research methods used by the dissertations.

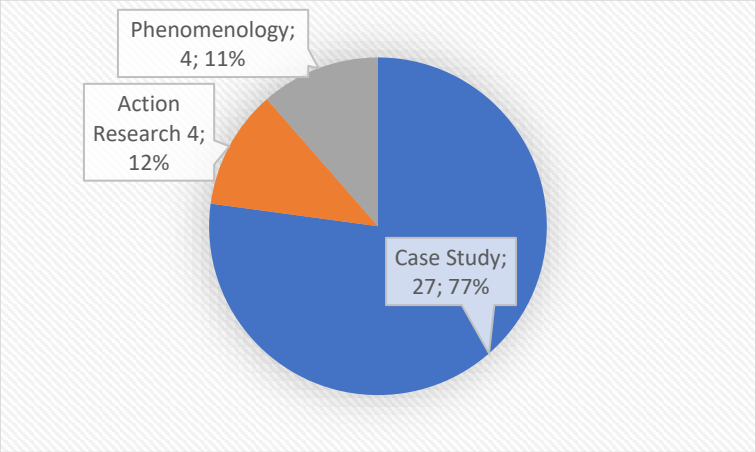

Figure 11 Distribution of the theses/dissertations by qualitative research method

Figure 11 shows that the majority of qualitative theses/dissertations used the case study design (27-77%), followed by the phenomenological design (4-12%). Additionally, no thesis employs grounded theory. Among the qualitative studies, the high number of case studies is also expected. Upon reviewing the dissertation purposes, it was noted that many studies examined both students and teachers/pre-service teachers (e.g., awareness, misconceptions) in a variety of ways. The use of case studies in these theses/dissertations is not surprising, since they allow a deeper look into the development and reveal the situation. Figure 12 shows the distribution of the sample groups of the theses/dissertations analyzed.

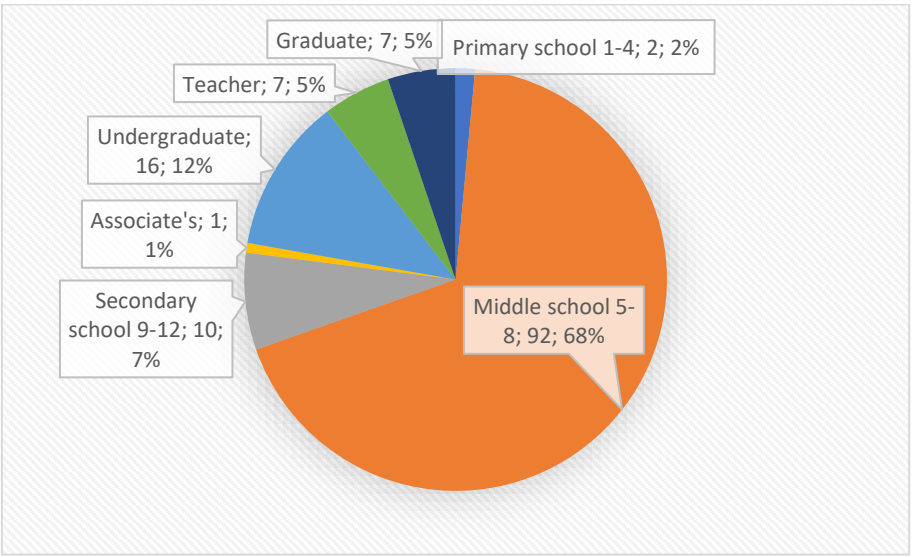

Figure 12 Distribution of the theses/dissertations by sample group

The theses/dissertations evaluated in this study are classified into groups such as primary school (1-4), middle school (5-8), secondary school (9-12), associate's, undergraduate, teacher, and graduate. According to Figure 12, the theses/dissertations analyzed in the current study most commonly interviewed middle schoolers in the 5th, 6th, 7th, and 8th grades (68%). As a result, the majority of the theses/dissertations prepared in the learning area of statistics and probability were prepared by middle school students, followed by undergraduate students (12%) and secondary school students (7%). Additionally, there are very few studies conducted with associate's degree students (1%) and primary school students (2%). A greater number of studies are conducted with teachers and graduate students than with students in primary schools and with associate's degrees. It appears, however, that studies using these sample groups are uncommon when viewed holistically. It is important to note one point. Due to the introduction of the 4+4+4 system in the 2012-2013 school year, 5th-grade students previously attending primary school started receiving education as middle school students. This study examined 5th-grade students as middle schoolers. Figure 13 shows the sample sizes of the theses/dissertations grouped in 100ths.

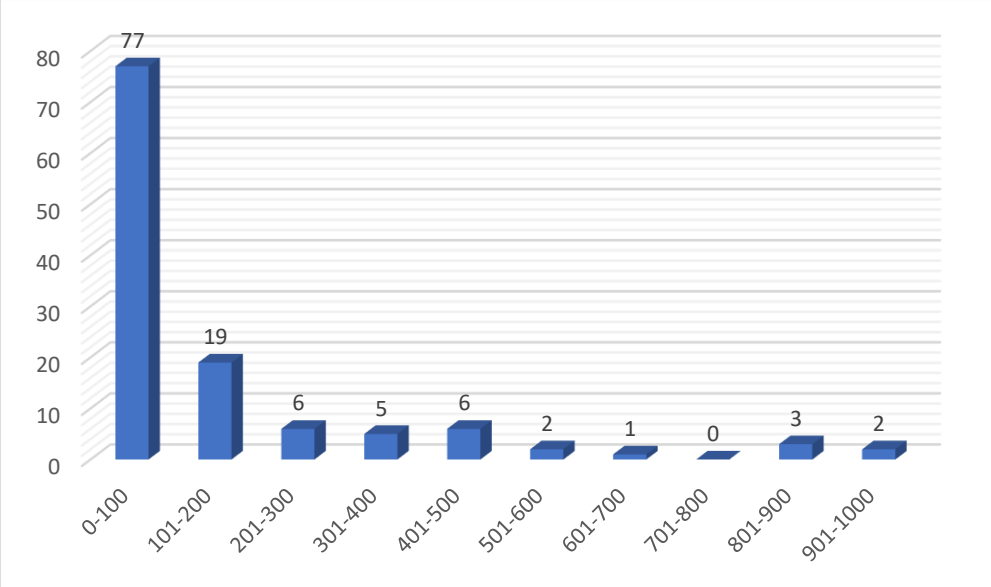

Figure 13 Distribution of the theses/dissertations by sample size

Based on the distribution of sample sizes used in dissertations, it was found that 77 theses/dissertations used a sample size ranging from 0 to 100 people (63%). The samples in 19 theses/dissertations consisted of 101-200 people (16%). There is no dissertation whose sample size ranges from 701 to 800 people. It's not much of a surprise to see such a result. According to the distribution of dissertation purposes, case studies and experimental studies

tend to involve 0 to 100 participants. Figure 14 shows the distribution of the data collection tools used in the dissertations.

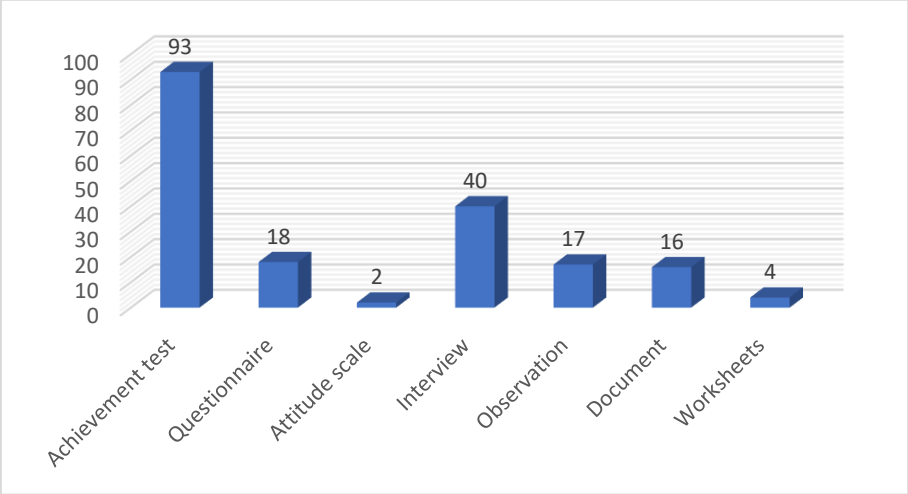

Figure 14 Distribution of the theses/dissertations by data collection tools

Figure 14 shows that theses/dissertations tend to use achievement tests to collect data (93-49%), followed by interviews (40-21%). Data collection tools such as questionnaires (11%), observations (9%), and documents (%8) are less popular. Data collection tools such as attitude scales (1%) and worksheets (2%) are the least preferred. Accordingly, it is compatible for achievement tests to be used more in data collection along with teaching practices being the subject of more dissertations. Figure 15 shows the results of dissertations' data analysis methods.

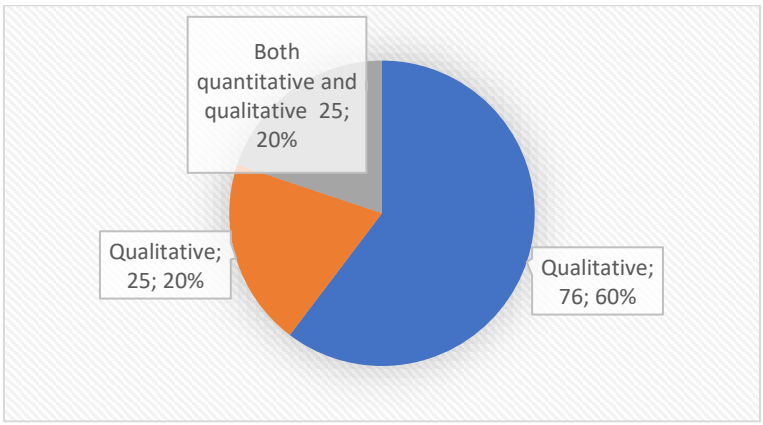

Figure 15 Distribution of the theses/dissertations by data analysis method

A review of the data analysis methods used by the theses/dissertations revealed that more than half (76-60%) were quantitative in nature. Among the theses/dissertations reviewed, the proportions of those utilizing qualitative analysis methods and those employing

both qualitative and quantitative analysis methods were the same (25-20%). According to this study, the high use of quantitative methods as data analysis methods is consistent with the data collection methods used in the theses/dissertations since achievement tests, which are more likely to be analyzed with quantitative methods, are used more frequently. As a result of classifying quantitative analysis methods within themselves, Figure 16 was created.

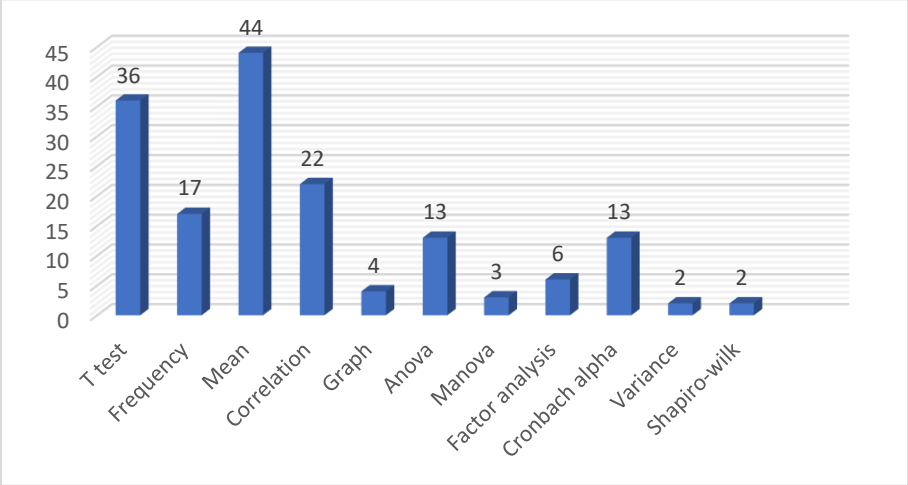

Figure 16 Distribution of the theses/dissertations by quantitative data analysis method

Figure 16 shows that in the learning area of statistics and probability, theses/dissertations using the quantitative analysis method tend to use descriptive quantitative data analysis methods (e.g., mean, graph). There is a tendency to prefer descriptive analysis methods over predictive techniques. Based on the classification of qualitative data analysis methods within themselves, Figure 17 was created.

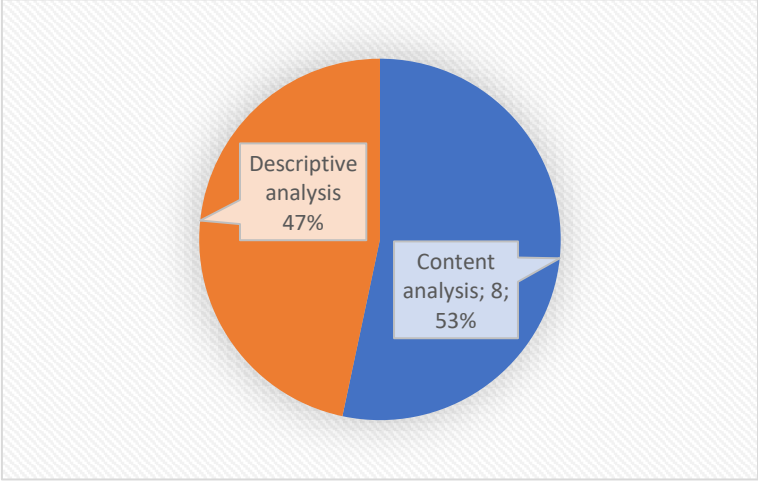

Figure 17 Distribution of the theses/dissertations by qualitative data analysis method

According to the findings in Figure 17, the percentages of the content analysis method (8-53%) and descriptive analysis method (7-47%) used in the theses/dissertations as qualitative data analysis methods are close to each other. Table 3 was created by analyzing the teaching practices used in the dissertations.

Table 3 Teaching practices used in the dissertations

Teaching Practices	Thesis Identifier	Frequency	Percentage
Technology-assisted	T3, T4, T9, T16, T28, T45, T46, T49, T53, T55, T65, T78, T83, T85, T96, T117, T120	17	28%
Realistic mathematics teaching-based	T52, T88, T97, T110	4	7%
Cooperation-based	T11, T34, T38, T71	4	7%
Multiple intelligence-based	T12, T26, T60	3	5%
Constructivist approach-based	T15, T44	2	3%
Game-assisted	T22, T115	2	3%
Metacognitive strategies-based	T39, T116	2	3%
Problem solution-assisted	T58, T91	2	3%
Professional development program	T81, T111	2	3%
Drama-based	T2	1	2%
Data driven (supported with the calculator)	T6	1	2%
Graf theory-based	T10	1	2%
Portfolio-based	T13	1	2%
Internet-assisted	T20	1	2%
Interdisciplinary teaching-based	T23	1	2%
Concrete models-based	T25	1	2%
Realistic mathematics and constructivist approach-based	T31	1	2%
Game programming-based	T32	1	2%
Creative drama-based	T41	1	2%
Concept map and Vee diagram-assisted	T66	1	2%
Exam-based teaching-assisted	T67	1	2%
Writing activities-based	T75	1	2%
Information exchange technique-based	T79	1	2%
Problem posing-assisted	T93	1	2%
Flipped learning-based	T98	1	2%
Statistical problem solving-based	T105	1	2%
Erroneous solution method-based	T106	1	2%
Digital competence-based	T107	1	2%
Game-assisted	T115	1	2%
Project-based	T48	1	2%

In examining the teaching practices used in the dissertations, it was found that more than a quarter used "technology-assisted teaching practices" (17-28%). This is followed by "realistic mathematics education-based teaching practices" and "cooperation-based teaching

practices" (4-7%). There were three theses/dissertations using "multiple intelligence-based teaching practices" out of all the dissertations. Even though many other teaching practices were used in the dissertations, their percentage was quite low (see Table 3).

Analyzing the dissertation results led to the creation of Table 4. It was observed that many different results emerged from the theses/dissertations when they were evaluated. According to 25% of the dissertations, the teaching practice carried out led to significant improvements in student achievement. It is followed by the finding that both pre-service teachers/teachers and students have difficulties/misconceptions regarding statistics and probability concepts. Furthermore, studies examining the effects of teaching practices on the development of different components (e.g., achievement, attitude) have generally found positive results. Students were more likely to be involved in scale development and correlation studies than teachers. According to the results, some variables (e.g., probabilistic reasoning-mathematical reasoning) were significantly related, while some variables (e.g., knowledge level-learning styles) were not significantly related. According to an evaluation of theses based on scale development studies, theses/dissertations were conducted to develop scales for attitudes toward statistics and literacy. Additionally, the professional development programs designed for mathematics teachers/pre-service teachers provided support in numerous areas. It was determined in studies examining textbooks that they were insufficient in a variety of ways. According to the results of the study, master's theses were more numerous than doctoral dissertations, and most of theses were conducted with the participation of 8^{th}-graders in the learning area of probability of occurrence. The quantitative research model and quasi-experimental design were both extensively used, and achievement and attitude scales were preferred. The main objective of the theses was to reveal the effectiveness of a particular method. The most important feature measured in the theses was achievement.

Table 4 Distribution of the theses/dissertations by finding

	Results			Thesis Identifier	Frequency	Percentage
Studies on students	Students have difficulties / misconceptions / lack of knowledge about the concepts of statistics and probability.			T1, T14, T18, T24, T27, T30, T35, T40, T42, T50, T62, T63, T64, T72, T73, T77, T82, T83, T92, T101, T10, T104, T109, T113, T119, T121, T122, T123, T124	29	16%
	Students are more successful in describing the data than in other thinking processes.			T17	1	0.5%
	The use of portfolio studies in statistics and probability teaching supports the teaching process.			T13	1	0.5%
	The teaching practice carried out	caused a significant increase in students' achievement		T3, T4, T9, T10, T11, T12, T15, T2, T22, T23, T26, T28, T31, T32, T33, T34, T38, T39, T41, T44, T45, T46, T48, T49, T52, T53, T54, T58, T60, T65, T66, T67, T75, T78, T85, T88, T90, T96, T98, T105, T106, T107, T110, T115, T117, T120	46	25%
		caused a significant increase in students' permanent learning		T2, T11, T23, T28, T34, T39, T52, T58, T 88, T97	10	5%
		caused a significant increase in students' attitudes		T3, T10, T25, T39, T52, T65, T67, T75	8	4.4%
		caused a significant increase in students' motivation		T22, T344, T88	3	2%
		caused a significant increase in students' intuitional thinking		T28, T54	2	1.5%
		caused a significant increase in students' metacognitive skills		T39, T75, T91, T110	4	2.2%
		caused a significant increase in students' perception of the usefulness of mathematics		T2	1	0.5%
		caused a significant increase in students' responsibility in mathematics lessons		T12	1	0.5%
		did not cause a significant increase in students' achievement		T2, T6, T16, T58, T71, T79, T97	7	4%
		did not cause a significant increase in students' permanent learning		T25, T67, T79	3	2%
		did not cause a significant increase in students' attitudes		T2, T6, T41, T49, T53, T66, T71, T85	8	4.4%
	Within the context of the teaching practice carried out	other variables (e.g., gender, family, education level, school type, peer collaboration)	have an effect on achievement	T5, T12, T80, T104	4	2.2%
			do not have an effect on achievement.	T3, T5, T8, T12, T15, T45, T80, T104	8	4.4%

	Correlation studies	There is no correlation between students' knowledge about the concepts of statistics and probability and their learning styles.	T54	1	0.5%
		There is a moderate and positive correlation between the mathematical reasoning skills and probabilistic reasoning skills of most students.	T36	1	0.5%
		There is a positive and significant correlation between students' statistical literacy and attitudes towards statistics.	T42	1	0.5%
		There is a positive and significant correlation between students' self-efficacy perceptions and general test achievement scores and between their attitudes towards mathematics and their achievement.	T80	1	0.5%
		There is a positive and significant correlation between students' attitudes towards mathematics lessons and attitudes towards statistics lessons. There is no significant correlation between students' anxiety about and achievement motivation effort towards mathematics lessons and their attitudes towards statistics lessons.	T47	1	0.5%
		Students' anxieties about statistics lessons prevent them from learning. Factors such as anxiety-hatred, benefit-importance, and love-interest have a statistically significant effect on attitudes towards statistics; attitudes towards statistics and benefit-importance and love-interest are positively correlated while anxiety-hatred is negatively correlated with attitudes towards statistics. While there is a correlation between attitudes towards statistics and self-esteem, there is no correlation between attitudes towards statistics and problem solving and state anxiety.	T100	1	0.5%
		Statistics course achievement is significantly correlated with the variables of GPA, University Entrance Exam score and duration of education.	T99	1	0.5%
		There is a significant correlation between the ability to draw and understand graphs and interpret graphs.	T8	1	0.5%
	Scale development studies	Mathematical language skills of students in statistics consisted of three interrelated sub-factors: symbolic language, verbal language and visual language. In addition, mathematical reading comprehension has a high effect on mathematical language, while the effect of mathematical writing skill on mathematical language is not significant. Concept knowledge has a high effect on mathematical writing and reading comprehension skills.	T61	1	0.5%
		The scale of attitude towards statistics consists of three factors: fear and trust, occupation and importance and love, pleasure and interest.	T7	1	0.5%
		Statistical literacy scale consists of the sub-headings of randomness, dependent and independent events, probability of occurrence of events, estimation, expectation, measures of frequency, central tendency and dispersion, normal distribution, hypothesis testing, estimation intervals and correlation.	T19, T43	2	1.5%
Studies carried out on teachers / pre-	Mathematics teachers/pre-service teachers have difficulties/misconceptions/lack of knowledge regarding the concepts of statistics and probability.		T29, T51, T56, T57, T59, T68; T70, T74, T76, T84, T86, T93, T94, T95,T102, T112, T114, T118, T126	19	10.9%

service teachers	When the probability approaches (experimental, theoretical, subjective) used by the Mathematics Teachers were examined, the success levels of those using the theoretical approach were found to be higher.		T21	1	0.5%
	Mathematics teachers/pre-service teachers have a high ability to notice some points in the teaching of statistics, but they are insufficient to notice some other points.		T87	1	0.5%
	Mathematics teacher/pre-service teachers have various difficulties in using dynamic statistics software in teaching statistics.		T89	1	0.5%
	The self-efficacy beliefs of the mathematics teachers/pre-service teachers towards the course of statistics were at a high level and their attitudes towards the course of statistics were at a moderate level.		T29	1	0.5%
	Pre-service mathematics teachers' statistical self-efficacy beliefs are low and moderate.		T74	1	0.5%
	Correlation studies	There is no significant correlation between pre-service mathematics teachers' self-efficacy beliefs and achievement.	T74	1	0.5%
		While there is a positive and significant correlation between mathematics teachers/pre-service teachers' statistical concepts achievement test achievement and self-efficacy beliefs about and attitudes towards the course of statistics, there is no significant correlation with gender.	T29	1	0.5%
		There is a significant correlation between pre-service teachers' statistical literacy scores and attitudes towards statistics.	T69	1	0.5%
	Scale development studies	The total effect values of pre-service teachers' emotions, values, cognitive competences and interests on their statistical gains are high and statistically significant. The total effect values of the mathematics achievement and effort variables on statistical gains are small but statistically significant. On the other hand, students' attitudes towards the difficulty of statistics do not have a total effect on explaining their statistical gains.	T37	1	0.5%
	The development programs prepared for mathematics teachers/pre-service teachers helped them eliminate their deficiencies.		T81, T111, T116	3	2%
Studies examining textbooks / theses	The part of the textbook on data processing learning area was mostly found insufficient in the themes of learning process, mathematical skills and measurement and evaluation. When examined in terms of values education, the textbook was found to be sufficient.		T108	1	0.5%
	It was concluded that the highest number of studies on statistics was carried out in Middle East Technical University, that the number of theses published in 2019 was higher than other years, and that the number of master's theses was higher than the number of doctoral dissertations. The highest number of theses was carried out with the participation of 8th grade students in the sub-learning area of Probability of Occurrence of Simple Events and the sample size was preferred in the range of 31-100. Researchers preferred scales such as achievement and attitude more as data collection tools and they used the quantitative research model and quasi-experimental design extensively. It was also concluded that the most measured feature in the theses was achievement and the theses mainly aimed to reveal the effectiveness of a certain method.		T125	1	0.5%

Conclusion and Discussion

This study focused on master's theses and doctoral dissertations in statistics and probability. The literature emphasizes the importance of examining theses/dissertations to determine current trends and identify future research needs. Furthermore, research results can guide policy-making institutions (Baki et al., 2011; Çiltaş et al., 2012; Ulutaş & Ubuz, 2008; Yücedağ & Erdoğan, 2011). According to the existing research, there should be more research in the learning area of statistics and probability (Garfield & Ahlgren, 1988; Karakaş, 2021; Lubiensky & Bowen, 2000; Tereci, 2017). The current trends in statistics and probability can be revealed by examining theses/dissertations prepared in the learning area of statistics and probability.

The number of master's theses compared with the number of doctoral dissertations is higher when the distribution of theses/dissertations is broken down by type; 86% of these theses/dissertations are master's theses, while 14% are doctoral dissertations. In other words, the number of master's theses is about six times that of doctoral dissertations. There were similar results in studies that examined trends in dissertations, albeit in different fields (Albayrak, 2017; Atasever, 2019; Kutluca et al., 2016; Yücedağ & Erdoğan, 2011). This result can be attributed to several factors. Firstly, we have more master's programs than doctoral programs in our country. As a result, master's theses are expected to exceed doctoral dissertations in number. Due to the higher number of faculty members required for the opening of a doctoral program, the number of doctoral dissertations may have been lower than desired. The low number of doctoral dissertations may also be due to the low number of students admitted to doctoral programs compared to master's programs. Furthermore, some theses/dissertations could not be reached due to restricted access, so the most recent information on master's theses and doctoral dissertations may not be available.

Over the years, there are ups and downs in the number of dissertations, as evidenced by the distribution of dissertations. There was a remarkable increase in the number of theses in 2010, 2014 and 2019. A significant increase can be noted between 2003 and 2010. It is not surprising to see this increase. A special emphasis was placed on statistics and probability in 2005, when the constructivist approach was introduced (Ministry of National Education [MoNE], 2005). Accordingly, it is likely to be a topic of significant research in this context. However, decreases were observed in 2011, 2015, 2017 and 2020. According to the results obtained in multiple years (2007, 2011, 2019), particularly in international exams (e.g.,

TIMSS), students' scores in the learning area of data and probability were moderate (MoNE, 2020; Yıldırım et al., 2016). It is evident from these results that this area needs more research.

Moreover, the number of theses/dissertations written in the learning area of statistics and probability is higher in 2019 than in previous years. It is possible that the curriculum updated in 2018 contributed to the change and increase. There were no theses/dissertations in the learning area of statistics and probability in the early 2000s. Despite the paradigm shifts in the curriculum since 2005, the number of these theses/dissertations has not increased consistently. It was noted that master's theses fluctuated more than doctoral dissertations over time when examining how they changed over time. A correlation was found between the fluctuation in the number of master's theses and the general trend in the number of dissertations.

Upon examining the distribution of theses/dissertations across the universities, it was found that many universities have theses published in this area. As compared to other universities, Middle East Technical University published the most theses/dissertations with 18 theses/dissertations. There are 10 theses/dissertations at Marmara University and 9 at Gazi University. The fact that these universities have produced more theses/dissertations can be attributed to the fact that the mathematics education department was established earlier. Additionally, these universities may have completed more theses/dissertations due to the higher number of researchers doing graduate studies there. These finding is in line with the findings obtained from studies examining trends in graduate studies in different fields (Albayrak, 2017; Atasever, 2019; Kutluca et al., 2016; Tabuk et al., 2018; Tereci, 2017; Yücedağ & Erdoğan, 2011). Similar results were obtained by Dinç (2021) in the learning area of statistics and probability through theses/dissertations conducted with secondary school students. Researchers have found that the theses prepared at Atatürk University are more in number than those in other universities (Doğan, 2018; İnceoğlu, 2009; Özey, 2019). Compared with these studies in the literature, it is different in this regard. It is also noteworthy that state universities produce the majority of theses. Only two foundation universities have studied this field and three theses/dissertations have been completed (two in Yeditepe University and one in Zirve University).

The number of female authors of the theses/dissertations is higher than the number of male authors when the genders of the authors are examined. Female researchers completed 61% of dissertations, while male researchers completed 39%. In this regard, it can be said that female researchers are more inclined to pursue graduate studies. According to the results

obtained, the number of women continuing their education is increasing. This is also consistent with the analyses made by the General Directorate of the Status of Women. According to the report, women's participation in higher education has increased significantly (Kadın ve Eğitim, 2008). Other studies have reported similar results (Atasever, 2019). Additionally, some studies found that there was no difference in authorship rates between males and females in doctoral dissertations (e.g., Tereci, 2017), while in others, male authors were more common (Yücedağ & Erdoğan, 2011).

It was found that four out of five theses/dissertations were published in Turkish. This result is expected since Turkish is the language of instruction in most of the universities. Similar results were found in studies examining the publication languages of theses/dissertations (Atasever, 2019; Çiltaş et al., 2012; Tabuk et al., 2018; Tereci, 2017; Ulutaş & Ubuz, 2008; Yücedağ & Erdoğan, 2011).

Three main headings were used to analyze the distribution of subjects in the dissertations. These headings are statistics, probability, and statistics and probability. A majority of theses/dissertations (54%) dealt with statistics. Probability, on the other hand, accounted for 28% of the dissertations. About one in five theses/dissertations is devoted to statistics and probability (18%). There are several reasons why more studies are being conducted in the field of statistics. The first is that statistics are more intensely taught at primary, middle, and high school levels. Primary school curriculum do not include any probability objectives, but middle school curriculum includes at the 8^{th} grade level. Researchers may have focused more on statistical knowledge and skills as a result of these findings. According to Dinç (2021), there are more theses/dissertations on probability conducted with secondary school students in Turkey than on statistics. It was revealed that studies on probability were more common than those on statistics in the study of Garfield and Ben-Zvi (2007). Thus, the results of the current study contradict with these results reported in the literature.

Based on the distribution of keywords used in theses, it was found that "probability" appeared most frequently (n=28). There were 18 uses of the words "teacher", "attitude", and "statistics education". "Mathematics education" and "achievement" were both used 14 times. There was a wide range of keywords following them. While half of the theses/dissertations deal with statistics, the word "probability" is the most commonly used keyword. Because the keywords reflect the theses/dissertations done, it is necessary that the content of the prepared theses/dissertations is compatible with the keywords.

The theses/dissertations prepared in the field of statistics and probability were examined in terms of their purposes. Approximately one-third (37% of all dissertations) examined the effect of teaching practices conducted on students' knowledge and skills about statistics and probability on the development of different components. In their examination of articles and theses/dissertations prepared in the learning area of statistics and probability, Tosun and Ünal (2019) also found that the studies were primarily focused on "testing the effectiveness of teaching methods". According to Garfield and Ahlgren (1988), more research should be conducted to support students' ability to perceive statistics and probability concepts correctly. This emphasis is reflected in the theses/dissertations conducted in the field when viewed from this perspective.

In a review of the dissertations, it was found that one-fourth (25% of the dissertations) examined students' knowledge or misconceptions about the concepts of statistics and probability. The next largest group of theses/dissertations (16%) focused on examining teachers' knowledge/misconceptions about statistics and probability. In total, 41% of theses/dissertations examined student and teacher knowledge / misconceptions about the concepts of statistics and probability. It is reasonable to say that four out of ten theses/dissertations were developed with this goal in mind. The results of Garfield and Ben-Zvi's (2007) study were similar. According to Zieffler et al. (2008), the theses/dissertations on statistics and probability at the university level are shaped by similar purposes. A total of 4% of the theses/dissertations were aimed at improving pre-service teachers' knowledge of statistics and probability. Garfield and Ben-Zvi (2007) drew attention to the existence of studies carried out for similar purposes in their study. While there are theses/dissertations carried out for different purposes, it has been discovered that these are in the minority. Most of the theses/dissertations were written with the purpose of making participants gain various knowledge and skills related to statistics based on an educational practice. Following this are theses/dissertations aiming to explore teachers'/pre-service teachers' knowledge and misconceptions about probability and statistics. Over three-quarters of theses/dissertations (78% of them) were structured around these three purposes.

A quantitative research method was used in half of the theses/dissertations examined in the current study (52%). The qualitative method was used in about one out of four theses/dissertations (28%). There was one mixed method dissertation out of every five. Experimental methods were preferred by 73% of theses/dissertations employing the quantitative method. Therefore, three out of every four quantitative theses/dissertations

preferred experimental methods. Following this is the survey method. Since one of every three theses/dissertations examined the effects of teaching practices on different components, this result is not surprising. It is possible to say that researchers prefer experimental studies because they want to prove the effectiveness of the teaching method they are focusing on. A point needs to be noted here, however. For experimental methods, traditional teaching methods are applied to the control group, while targeted teaching methods are applied to the experimental group. Because the constructivist approach has been adopted since 2005, it can be assumed that the traditional method will present some difficulties in the control group. Karadağ (2009) emphasized this point, stating that comparing the effectiveness of traditional and alternative methods in experimental studies would undermine the validity of the study. According to Becker (1996), experimental studies make up less than 30% of the literature. The results obtained in this study are inconsistent with what was found in the previous study from this perspective. In their studies, Judi and Sahari (2013), Tosun and Ünal (2019) and Dinç (2021) found similar results, revealing that quantitative methods were used mainly in the studies that examined statistics and probability. They stated that experimental methods were the most preferred quantitative methods in these experiments. In terms of consistency, these results are in line with those obtained in the current study.

A majority of theses/dissertations that preferred the qualitative method used case studies (77%), followed by action research (12%) and phenomenological research (11%). No theses/dissertations employed grounded theory as a method. A possible explanation for the widespread use of case studies in qualitative theses/dissertations is their attempt to investigate smaller groups in greater detail. A number of studies have examined the trends in studies conducted in the field of mathematics education, and they have concluded similar findings (Baki et al., 2011; Çiltaş, 2012; Çiltaş et al., 2012; Ulutaş & Ubuz, 2008; Yaşar & Papatga, 2015; Yücedağ & Erdoğan, 2011).

The sample of theses/dissertations prepared in the learning area of statistics and probability mainly comprised middle school students (68%). A number of factors can be considered when evaluating the fact that more studies have been conducted on middle school students. First of all, the learning area of statistics and probability at the middle school level contains a high number of objectives and class hours. At middle school, 60 class hours are allocated to the accomplishment of 19 objectives in the learning area of statistics and probability. Primary school students have nine objectives, whereas high school students have six. Due to the high number of objectives and class hours, statistics and probability may have

become a more remarkable research area at middle school. Undergraduates (12% of the sample) accounted for the second group of students being studied extensively in theses. There may be a preference for undergraduate students due to their greater availability compared to other sample groups. The researchers may have chosen to work with this sample group due to the longer-term permission processes for working with other sample groups. Several studies examining the trends of studies in various fields have produced similar results (Karakaş, 2021; Koç, 2020; Küçüközer, 2016; Ozan & Köse, 2014; Ubuz & Ulutaş, 2008). The number of theses/dissertations involving other sample groups is relatively small (secondary school students make up 7%, teachers and graduate students make up 5%, primary school students make up 2%, and associate's degree students make up 1%). Interestingly, no study involved special education groups and mathematics educators. Due to the importance of the learning area of statistics and probability today, it is considered important to conduct studies with all sample groups, especially with those that have never been studied or have been studied less.

As a result of examining the sample sizes in the dissertations, it was found that groups between 0-100 people were most preferred, followed by 101-200 people. The number of theses/dissertations with different sample sizes is relatively small, even though there are some studies with large samples. There are two main reasons why smaller sample groups are used in the studies. Research method might be the first. Especially in qualitative research, it is expected to work with smaller sample groups to be able to answer the research question. In addition, it is possible to consider this to be an economic tendency. Usually, when reaching participants is difficult both financially and morally, it is advisable to work with fewer participants. This finding is a finding reported in studies on statistics and probability and in other studies, as well (Çiltaş, 2012; Dinç, 2021; Özey, 2019; Tabuk et al., 2018; Tatar et al., 2011; Tosun & Ünal, 2019). The study trends in the learning area of statistics and probability, for example, were examined by Tosun and Ünal (2019) and Dinç (2021). Tosun and Ünal (2019) found that the most number of studies were conducted with 50-100 participants, while Dinç (2021) found that 31-100 participants were involved in the most studies.

Nearly half of the theses/dissertations used achievement tests (49%), based on the distribution of the data collection tools used. Since achievement tests can be used both qualitatively and quantitatively in research methods, they can be used more extensively as a data collection tool. There have been studies with similar results (Dinç, 2021; Tosun & Ünal, 2019). Interviews were found to be the second most preferred data collection tool (21%).

Although other tools (e.g., attitude scales, documents) were also preferred, their rate of use was low.

Based on the data analysis methods preferred by the dissertations, quantitative methods were preferred over qualitative and mixed methods. Quantitative research methods favored the descriptive method most. Qualitative data analysis theses/dissertations used content analysis and descriptive analysis methods at about the same rates. A review of the literature shows that similar results have been reported in other studies (Albayrak & Çiltaş, 2017; Arık & Türkmen, 2009).

According to an evaluation of the teaching practices used in the dissertations, technology-assisted teaching environments were used more than others. A technology-assisted teaching environment was preferred by one in four theses/dissertations that tested a teaching practice (28%). The emergence of such a result can be attributed to several factors. The first is the growing awareness of technology's importance today. It may have been triggered by the Covid-19 pandemic to associate education with technology in an effort to improve teaching methods. Additionally, researchers might be motivated to include such teaching practices in their theses/dissertations by the positive results obtained from studies. According to many researchers, statistics education should be integrated with technology to increase the effectiveness of the instructional and educational process (Kayaly, 2013; Tishkovskaya & Lancaster, 2010). In an analysis of the statistics education studies conducted by Van der Merwe and Wilkinson (2011), only 15% were related to technology use. Accordingly, the literature results do not coincide with the current study's findings. Another study by Judi and Sahari (2013) identified computer-assisted collaborative learning environments as the most commonly used method in student-centered learning in statistics education. The results of this study support those of the current study. The theses/dissertations also highlighted "realistic mathematics education-based teaching practices" and "cooperative-based teaching environments" (7%) as preferred teaching practices. Five percent of all the theses used "multiple intelligence-based teaching environments" (n=3). Although many other teaching practices were used, their rate of use was found to be quite low (See Table 4).

A general examination of the results obtained from theses/dissertations prepared in the learning area of statistics and probability reveals several points. In the first place, students of all grade levels as well as teachers and pre-service teachers have difficulties/ misconceptions/ knowledge deficiencies regarding statistics and probability. This conclusion was reached in almost one out of four theses/dissertations (27%). Several different factors can contribute to

the difficulties experienced by students, teachers, and pre-service teachers. These causes include teaching processes, affective features, and cognitive characteristics. According to Zieffler et al. (2008), many university students attend introductory statistics courses with fear and anxiety, and these feelings last throughout the course. Several researchers have reached similar conclusions in this field (Sotos et al., 2007; Tosun & Ünal, 2019; Zamora Araya et al.; 2021; Zieffler et al., 2008). According to Sotos et al. (2007), students have deep and widespread misconceptions about the concept of inference, and even if they can compute statistics, they cannot interpret the results. According to Zieffler et al. (2008), university students do not correctly understand sampling distribution, measures of central tendency, and dispersion in statistics. According to Tosun and Ünal (2019), secondary school students have difficulty with line graphs. Students' achievement (16%) was also significantly improved by the various teaching practices applied in the dissertations. Students' achievement did not increase significantly as a result of the teaching practices employed in some dissertations, but the percentage of these theses/dissertations is very low (4%). Student achievement practices that resulted in significant gains in achievement were not able to increase student learning permanently. In 6% of dissertations, teaching practices increased the permanent learning of students in a significant way. In the case of the effects of teaching practices on student attitudes, the same results could not be obtained. Teaching practices were associated with significant changes in attitudes of students in only 4% of dissertations, but did not result in significant changes in 4% of dissertations. In addition, other variables (e.g., gender, family, education level, school type, peer collaboration) had no impact on achievement (4%). The theses/dissertations also yielded many other remarkable results (see Table-4).

Suggestions and Limitations

The current study is limited to the master's theses and doctoral dissertations prepared in the learning area of statistics and probability in Turkey. Therefore, it may be helpful to analyze other types of studies (e.g., articles, papers) related to this learning area, which will improve the content validity and reveal the situation in Turkey in a more comprehensive way.

A framework of codes was created based on the data obtained for analyzing the purposes and results sections of the studies. No analysis was conducted within the framework of the codes previously determined. The data can be analyzed using predetermined codes in future studies (e.g., Zieffler et al. 2011).

The current study also analyzed theses/dissertations that were uploaded to the Higher Education Council's website and completed between 2000 and 2021. A variety of keywords (e.g., graph, measures of central tendency) related to statistics and probability were used to locate these theses. This keyword search might not be able to reach all theses/dissertations in the database. It is possible to consider this as a limitation of the study

In general, the results obtained have important implications for researchers, teachers, the Ministry of National Education, and students involved in this field. As well as providing important insights for researchers regarding what types of studies are needed, the results obtained can reveal the trend in theses/dissertations in the field of statistics and probability. Moreover, curriculum developers can revise the curricula based on the results. In order to organize their teaching processes, teachers can take into account the results obtained. In addition, it might be worthwhile to focus on sample groups and subject areas that have received relatively less attention. Lastly, there are fewer doctoral dissertations, which allows for further research to be focused on doctoral theses.

Compliance with Ethical Standards

Research and Publication Ethics Statement

Before starting the study, this study was found ethically appropriate by the decision of Karamanoğlu Mehmetbey University Instutional Review Board dated 07.10.2021 and numbered 09-2021/170. Moreover, all the sources used both in the text and in the references section are included.

Statement of Interest

The authors declare that they have no known conflict of interest.

Türkiye'de İstatistik ve Olasılık Öğrenme Alanına İlişkin Hazırlanan Lisansüstü Tezlerin İncelenmesi

Özet:

Bu çalışma, Türkiye'de olasılık ve istatistik öğrenme alanına ilişkin lisansüstü tezlerin eğilimini incelemeyi amaçlamıştır. Çalışmada doküman analizi yöntemi kullanılmıştır. Toplanan verilerin analizinde nitel veri analizi yöntemi kullanılmıştır. Tezlerin yayın yılına göre dağılımının düzenli olmadığını ortaya çıkmıştır. Tezlerin çoğunun istatistiğin öğrenme alanında yazıldığı tespit edilmiştir. "Olasılık" kelimesi tezlerde kullanılan en popüler anahtar kelime olmuştur. Tezlerin daha çok "öğretim uygulamalarının farklı bileşenlerin gelişimi üzerindeki etkilerini incelemek" amacıyla yazıldığı görülmüştür. Tezlerde çoğunlukla nicel araştırma yöntemi tercih edilmiştir. Çalışmalara katılan katılımcı sayısının en fazla 0-100 aralığında olduğu ve çalışmalarda seçilen en fazla tercih edilen katılımcı grubunun ortaokul öğrencileri olduğu tespit edilmiştir. Teknoloji destekli öğretim ortamının diğer öğretim ortamlarına göre daha fazla kullanıldığı ortaya çıkmıştır. Sonuçlar genel olarak incelendiğinde hem öğrencilerin hem de öğretmenlerin/hizmet öncesi öğretmenlerin istatistik ve olasılık kavramları hakkında yanlış anlamalara ve bilgi eksikliğine sahip oldukları fark edilmiştir. Uygulanan öğretim uygulamaları öğrencilerin başarılarında çoğunlukla anlamlı bir artışa neden olmuştur.

Anahtar kelimeler: lisansüstü tezler, doküman incelemesi, istatistik ve olasılık.

References

Ader, E. (2016). Programlardaki veri öğrenme alanı içeriklerine bakış: Program verilerinin karşılaştırmalı incelemesi [Overview of data learning domain contents in programs: Comparative analysis of program data]. In M. F. Özmantar, A. Öztürk, & E. Bay (Eds.), *Reform ve değişim bağlamında ilkokul matematik öğretim programları* (pp. 267-292). Pegem Akademi.

Ader, E. (2018). Programlardaki veri ve olasılık öğrenme alanı içeriklerine karşılaştırmalı bir bakış [A comparative look at data and probability learning area contents in programs]. In M. F. Özmantar, H. Akkoç, B. Kuşdemir Kayıran, & M. Özyurt (Eds.), *Ortaokul matematik öğretim programları: Tarihsel bir inceleme* (pp. 275-306). Pegem Akademi.

Albayrak, E. (2017). *Descriptive content analysis of mathematical modeling research published in the field of mathematics education in Turkey* [Unpublished master thesis]. Atatürk University

Albayrak, E., & Çiltaş, A. (2017). Descriptive content analysis of mathematical modelling research published in the field of mathematics education in Turkey. *International Journal of Turkish Education Sciences*, *2017*(9), 258-283. https://dergi.org.tr/tr/pub/goputeb/issue/34356/380612

Arık, R. S., & Türkmen, M. (2009). Eğitim bilimleri alanında yayınlanan bilimsel dergilerde yer alan makalelerin incelenmesi. *International Congress of Educational Research,* Çanakkale On Sekiz Mart University, Antalya, *1*, 16.

Atasever, D. (2019). Analysis of the graduate which made between 2014-2018 years in mathematics education in Turkey [Unpublished master thesis]. Bolu Abant İzzet Baysal University.

Aziz, A. M., & Rosli, R. (2021, March). A systematic literature review on developingstudents' statistical literacy skills. *Journal of Physics: Conference Series,1806*(1), 012102. https://doi.org/10.1088/1742-6596/1806/1/012102

Baki, A., Güven, B., Karataş, İ., Akkan, Y., & Çakıroğlu, Ü. (2011). Türkiye'deki matematik eğitimi araştırmalarındaki eğilimler: 1998 ile 2007 yılları arası. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *40*(1), 57-68. http://www.efdergi.hacettepe.edu.tr/shw_artcl-394.html

Bakker, A.; Hahn, C.; Kazak, S. & Pratt, D. (2018). Research on probability and statistics education, Dreyfus, T., Artigue, M., Potari, D., Prediger, S., & Ruthven, K. (Eds.). *Developing Research in Mathematics Education: Twenty Years of Communication, Cooperation and Collaboration in Europe*, (pp. 46-59). Routledge.

Bargagliotti, A., Franklin, C., Arnold, P., Gould, R., Johnson, S., Perez, L., & Spangler, D. (2020). *Pre-K-12 Guidelines for Assessment and Instruction in Statistics Education (GAISE) report II.* American Statistical Association and National Council of Teachers of Mathematics.

Becker, B. J. (1996). A look at the literature (and other resources) on teaching statistics. *Journal of Educational and Behavioral Statistics*, *21*(1), 71-90. https://doi.org/10.2307/1165256

Corbin, J., & Strauss, A. (2008). *Basics of Qualitative Research: Techniques and procedures for developing grounded theory* (3rd ed.). SAGE. https://doi.org/10.4135/9781452230153.

Çiltaş, A. (2012). Content analysis of the graduate thesis and dissertations in mathematics educatiob in Turkey between 2005-2010. *The Journal of Academic Social Science Studies*, *5*(7), 211-228. https://doi.org/10.9761/JASSS235.

Çiltaş, A., Güler, G., & Sözbilir, M. (2012). Mathematics education research in Turkey : A content analysis study. *Educational Sciences: Theory and Practice*, *12*(1), 565-580. https://www.idealonline.com.tr/IdealOnline/pdfViewer/index.xhtml?uId=1922&ioM=Paper&preview=true&isViewer=true#pagemode=bookmarks

Dinç, S. (2021). *Analysis of postgraduate theses in data processing and probabilty learning areas* [Unpublished master thesis], Kocaeli University.

Doğan, M. (2018). *The examination of postgraduate thesis on classroom training in Turkey between 2013-2017* [Unpublished master dissertation], Gaziantep University.

Fraenkel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education.* McGraw-Hill.

Franklin, C., Kader, G., Mewborn, D., Moreno, J., Peck, R., Perry, M., & Scheaffer, R. (2005). *Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report: A Pre-K–12 Curriculum Framework.* American Statistical Association.

Franklin, C., Kader, G., Mewborn, D., Moreno, J., Peck, R., Perry, M., & Scheaffer, R. (2007). *Guidelines for assessment and instruction in statistics education (GAISE) report: A pre-K-12 curriculum framework.* American Statistical Association.

Gal, I. (2002). Adults' statistical literacy: Meanings, components, responsibilities. *International statistical review, 70*(1), 1-25. https://doi.org/10.2307/1403713.

Gall, M., Gall, J., & Borg, R. (2007). *Educational research: An introduction* (8th ed.). Pearson Education.

Garfield, J., & Ahlgren, A. (1988). Difficulties in learning basic concepts in probability and statistics: Implications for research. *Journal for research in Mathematics Education*, *19*(1), 44-63. https://doi.org/10.2307/749110.

Garfield, J., & Ben-Zvi, D. (2007). How students learn statistics revisited: A current review of research on teaching and learning statistics. *International statistical review*, *75*(3), 372-396. https://doi.org/41509878

Garfield, J., & Ben-Zvi, D. (2008). *Developing students' statistical reasoning: Connecting research and teaching practice.* Springer Science & Business Media.

Hardy, G. H. (2004). *A mathematician defense.* Tübitak Popüler Bilim Kitapları.

İnceoglu, G. (2009). Evaluation of theses in the field of mathematics education and mathematics teaching. *Education Sciences, 4*(3), 1046-1052. https://doi.org/19827/212432.

İncikabı, L., Serin, M. K., Korkmaz, S., & İncikabı, S. (2017). A research on mathematics education studies published between 2009-2014 in Turkey. *Adıyaman University Journal of Educational Sciences, 7*(1), 1-19. https://doi.org/10.17984/adyuebd.325368.

Jin, Y. (2004). The development of the China network digital library of theses and dissertations. *Online Information Review*, *28*(5), 367-370. https://doi.org/10.1108/14684520410564299.

Judi, H. M. & Sahari, N (2013). Student centered learning in statistics: Analysis of systematic review *Procedia - Social and Behavioral Sciences, 103*, 844 – 851. https://doi.org/10.1016/j.sbspro.2013.10.406.

Kadın ve eğitim. (2008). *T.C. Başbakanlık Kadın Statüsü Genel Müdürlüğü*. Politika Dokümanı.

Karadağ, E. (2009). A Thematic Analysis on Doctoral Dissertations Made In the Area of Education Sciences, *Ahi Evran University Journal of Kırşehir Education Faculty, 10*(3), 75-87. https://doi.org/59508/855693.

Karakaş, G. (2021). *The thematic, methodological and statistical analysis of flipped learning theses and dissertations in Turkey* [Unpublished master thesis], Maltepe University.

Kayaly, D. E. (2013). *Towards more real-live teachings of business statistics: a Review of Challenges, Teaching Innovations and Strategies for Reform in Egypt,* Working Papers 2013/21, Maastricht School of Management.

Kayhan, M., & Özgün-Koca, S. A. (2004). Research subjects in mathematics education: 2000-2002. *Hacettepe University Journal of Education, 26,* 72-81. https://doi.org/8600/107083.

Koç, D. (2020). *An investigation on theses and dissertations on mathematical modeling in Turkey the last two decades* [Unpublished master thesis]. Middle East Technical University.

Kutluca, T., Hacıömeroğlu, G., & Gündüz, S. (2016). Evaluation of basic filed studies on computer assisted mathematics teaching in Turkey. *Journal of Theory and Practice in Education, 12,* 1253-1272

Küçüközer, A. (2016). An overview of the ocdtoral thesis in science education, *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 10*(1), 107-141 . https://doi.org/10.17522/nefefmed.54132.

Leavy, A., Meletiou-Mavrotheris, M., & Paparistodemou, E. (2018). Statistics in early childhood and primary education: Supporting early statistical and probabilistic htinking. Springer.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Lubienski, S. T., & Bowen, A. (2000). Who's counting? A survey of mathematics education research 1982–1998. *Journal for Research in Mathematics Education, 31*(5), 626-633. https://doi.org/10.2307/749890.

Miles, M, B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded Sourcebook* (2nd ed). Sage.

Ministry of National Education [MoNE] (2005). *İlköğretim matematik dersi (6-8. sınıflar) öğretim programı* [Elementary mathematics (6th-8th grades) curriculum]. Devlet Kitapları Müdürlüğü Basımevi.

Ministry of National Education [MoNE] (2020). *TIMSS 2019 Türkiye Preliminary report*, Education Analysis and Evaluation Reports Series.

National Council of Teachers of Mathematics [NCTM] (2000). *Principles and standards for school mathematics.* NCTM.

Ozan, C., & Köse, E. (2014). Research trends in curriculum and instruction. *Sakarya University Journal of Education, 4*(1), 116-136. https://dergipark.org.tr/tr/pub/suje/issue/20635/220033

Özey, K. (2019). *Examination of graduate thesis in algebra learning: Turkey sample between 2010-2018* [Unpublished master thesis]. Bursa Uludağ University.

Özkaral, T. C., & Mentiş-Taş, A. (2017). Examination of master's theses in the field of social studies and comparative education: A metasynthesis study. *Electronic Turkish Studies, 12*(25), 651-670. https://doi.org/10.7827/TurkishStudies.12143.

Rhoades, E. A. (2011). Literature reviews. *The Volta Review*, 353-368. https://Rhoades2011LiteratureReviews-PrinterProof.pdf.

Sevencan, A. (2019). *Investigation of theses and dissertations in the field of mathematics education in Turkey* [Unpublished master thesis]. Necmettin Erbakan University.

Sevinç, B. (2001). Postgraduate education practices, problems and suggestions in Turkey. *Ankara University Journal of Faculty of Educational Sciences (JFES), 34*(1), 125-137. https://doi.org/10.1501/Egifak_0000000052.

Shaughnessy, M., J. (2007). Research on Statistic learning and reasoning. In F. Lester (Ed.) Second *Handbook of Research on Mathematics Teaching and Learning* (pp.957-1002) National Council of Teachers of Mathematics.

Sotos, A. E. C., Vanhoof, S., Van den Noortgate, W., & Onghena, P. (2007). Students' mis conceptions of statistical inference: A review of the empirical evidence from research on statistics education. *Educational Research Review, 2*(2), 98-113. https://doi.org/10.1016/j.edurev.2007.04.001.

Suri, H., ve Clarke, D. (2009). Advancements in research synthe's is methods: From a methodologically inclusive perspective. *Review of Educational Research, 79*(1), 395-430. https://doi.org/10.3102/0034654308326349.

Tabuk, M., İnan, M. & Tabuk, M. (2018). Examining the mathematical skills in preschool children in terms of some variables. *Erzincan University Faculty of Education, 20*(1), 184-201 . https://doi.org/10.17556/erziefd.290963.

Tarman, B., Acun, İ. & Yüksel, Z. (2010). Sosyal bilgiler eğitimi alanındaki tezlerin değerlendirilmesi. *Gaziantep Üniversitesi Sosyal Bilimler Dergisi, 9*(3), 725-746.

Tereci, A. (2017). *Comparative analysis of post-graduate theses conducted between the years 2010-2017 in the field of mathematics education in Turkey according to certain standards* [Unpublished master thesis]. Gaziantep University.

Tereci, A., & Bindak, R. (2019). Comparative analysis of post-graduate theses conducted between the years 2010-2017 in the field of mathematics education in Turkey according to certain ctandards. *Muğla Sıtkı Koçman University Journal of Education, 6*(1), 40-55. https://doi.org/10.21666/muefd.485737.

Tatar, E., Akkaya, A., & Kağızmanlı, T. (2011). An analysis of the materials constructed with geoGebra by primary prospective mathematics teachers and their views about dynamic mathematics software. *Turkish Journal of Computer and Mathematics Education*, *2*(3), 181-197. https://doi.org/10.17762/turcomat.v2i3.31.

Tishkovskaya, S.,& Lancaster, G. (2010). Teaching strategies to promote statistical literacy: Review and implementation. In C. Reading (Ed.), *Data and context in statistics education: Towards an evidence-based society. Proceedings of the Eighth International Conference on Teaching Statistics (ICOTS8, July, 2010), Ljubljana, Slovenia*. Voorburg: International Statistical Institute, *20*(2). www.stat.auckland.ac.nz/~iase/publications.php

Tosun, T., & Ünal, D. Ö. (2019). A content analysis of the studies about data and probability learning areas. *Ege Journal of Education*, *20*(1), 244-261. https://doi.org/10.12984/egeefd.489275.

Ulutaş, F., & Ubuz, B. (2008). Research and trends in mathematics education: 2000 to 2006. *İlköğretim Online, 7*(3), 614-626.

Van der Merwe, L., & Wilkinson, A. (2011). Mapping the field of statistics Education research in search of scholarship. *International Journal for the Scholarship of Teaching ve Learning*, *5*(1), 1-16. https://doi.org/10.20429/IJSOTL2011.050129.

Wach, E. (2013). *Learning about qualitative document analysis.* https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/2989/P%20InBrEf%202%20QDA%20FINAL2.PDF?sequence=4.

Watson J., M. (2006). Statistical literacy at School, *Growth and Goal. Lawrence Erlbaum Associates*, Publishers. 27-53.

Wild, J. C.; Utts, M. J. & Horton, N. J. (2018). What Is Statistics? In D. Ben-Zvi, K. Makar & J. Garfield (Eds) *International Handbook of Research in Statistics Education* (pp.5-36) Springer.

Yıldırım, A., Özgürlük, B., Parlak, B., Gönen, E., & Polat, M. (2016). *TIMSS 2015 National mathematics and science preliminary report Grades 4 and 8.*

TIMSS 2015 Ulusal matematik ve fen bilimleri ön raporu 4 ve 8. Sınıflar. Ministry of National Education, General Directorate of Assessment, Evaluation and Examination Services.

Yücedağ, T, & Erdoğan, A. (2011). Investigation of mathematics education studies according to some variables studied between 2000-2009 years in Turkey. *Gaziantep University Journal of Social Sciences, 10*(2) , 825-838. https://dergipark.org.tr/tr/pub/jss/issue/24242/257013?publisher=gantep%3B.

Yaşar, Ş. & Papatğa, E. (2015). The analysis of the graduate theses related to mathematics courses. *Trakya University Journal of Education, 5*(2), 113-124. https://dergipark.org.tr/tr/pub/trkefd/issue/21482/230218.

Yıldırım, A. & Şimşek, H. (2011). *Qualitative research methods in the social sciences*. Seçkin Yayıncılık.

Zamora Araya, J. A., Aguilar Fernández, E., & Guillén Oviedo, H. S. (2021). Educación Estadística: tendencias para su enseñanza y aprendizaje en educación secundaria y terciaria. *Revista Educación*, *46*(1), 518–537. https://doi.org/10.15517/revedu.v46i1.43494

Zieffler, A., Garfield, J., Alt, S., Dupuis, D., Holleque, K., & Chang, B. (2008). What does research suggest abou the teaching and learning of introductory statistics at the college level? A review of the literature. *Journal of Statistics Education*, *16*(2). https://doi.org/10.1080/10691898.2008.11889566.

Zieffler, A., Garfield, J., Delmas, R. C., Le, L., Isaak, R., Bjornsdottir, A., & Park, J. (2011). Publishing in SERJ: An analysis of papers from 2002–2009. *Statistics Education Research Journal*, *10*(2), 5-26. https://doi.org/10.52041/serj.v10i2.345.

App.-1 Thesis Review Form

The name of the thesis/dissertation			
The author and the advisor			
The type and year of the thesis/dissertation			
The university where the thesis/dissertation was conducted			
The subject of the thesis/dissertation			
The purpose of the thesis/dissertation	.		
The language of the thesis/dissertation			
The gender of the author			
Keywords			
The results of the thesis/dissertation	☐Qualitative	☐Quantitative	☐ Mixed
	☐Action research	☐ Correlation	
	☐Phenomenology	☐ Survey	
	☐Case study	☐Causal comparison	

	☐Grounded theory	☐Experimental	
The sample of the thesis/dissertation	☐primary school (1-4)		
	☐middle school (5-8)		
	☐secondary school (9-12)		
	☐undergraduate		
	☐teacher		
	☐graduate		
	☐Other		
The sample size of the thesis/dissertation			
The data analysis techniques used in the thesis/dissertation	☐ Survey		
	☐ Achievement test		
	☐Questionnaire		
	☐Observation form		
	☐ Worksheets		
	☐Documents		
The data analysis techniques used in the thesis/dissertation	☐ Quantitative data analysis methods		☐ Qualitative data analysis methods
	☐ Descriptive	☐Predictive	☐Content analysis
	☐ Frequency	☐t test	☐Descriptive analysis
	☐Mean	☐Correlation	
	☐Graph	☐ Anova/Ancova	
	☐Standart deviation	☐ Manova/Mancova	
		☐Factor analysis	
		☐Regression	
		☐Non-parametric test	
		Cronbach Alpha	
The teaching practices used in the thesis/dissertation			

Appx.-2 Thesis/Dissertations used in the study

Abed, S. (2015). *Filistinli matematik öğretmen adaylarının istatistik dersi konularındaki kavram yanılgıları ve istatistik dersine yönelik öz yeterlilik inançları [Palestinian pre-service mathematics teachers' self-efficacy levels and performance in statistics]* [Unpublished master thesis]. Marmara Üniversitesi.

Akar, N. (2018). *İlköğretim matematik öğretmen adaylarının grafiklere ilişkin alan bilgilerinin antropolojik açıdan incelenmesi [An anthropological analysis of content knowledge of pre-service elementary mathematics teachers' on graphs]* [Unpublished master thesis]. Balıkesir Üniversitesi.

Akkaş, E. N. (2009). *6.-8.sınıf öğrencilerinin istatistiksel düşüncelerinin incelenmesi [Investigation of the middle school students' statistical thinking]* [Unpublished master thesis]. Abant İzzet Baysal Üniversitesi.

Akkaya, R. (2010). *Olasılık ve istatistik öğrenme alanındaki kavramların gerçekçi matematik eğitimi ve yapılandırmacılık kuramına göre bilgi oluşturma sürecinin incelenmesi [The investigation of knowledge construction process of concepts in probability and statistical learning field according to the realistic mathematic education and constructivism theory]* [Unpublished doctoral dissertation]. Uludağ Üniversitesi.

Alp, E. (2010). *Disiplinlerarası öğretim yaklaşımının öğrencilerin olasılık konusundaki akademik başarılarına ve öğrenmenin kalıcılığına etkisi [The effect of disciplinary teaching approach on students' academic successes and permanence of learning probability subject]* [Unpublished master thesis]. Karadeniz Teknik Üniversitesi.

Altınay, A. Ç. (2019). *8.sınıf öğrencilerinin dinamik istatistik yazılımı ile istatistiksel düşünme becerilerinin incelenmesi [Investigation of 8th grade students' statistical thinking skills with dynamic statistics software]* [Unpublished master thesis]. Mersin Üniversitesi.

Altınok, Z. (2020). *Sekizinci sınıf öğrencilerinin verilerin uygun grafikle gösterimine ilişkin tercih süreçlerinin incelenmesi [Investigation of the preference process for appropriate graphical display of data by eighth grade students]* [Unpublished master thesis]. Eskişehir Osmangazi Üniversitesi.

Andiç, T. (2012). *İlköğretim 8.sınıf matematik dersi permütasyon kombinasyon konusunun bilgisayar destekli öğretiminin öğrenci erişi düzeylerine ve tutumlarına etkisi [The effect of computer assisted education of the subject of permutation?combination of mathematics on 8th grade students? level of achievement, and attitudes]* [Unpublished master thesis]. Yeditepe Üniversitesi.

Arı, E. (2010). *İlköğretim 6.7 ve 8.sınıflarda matematik dersinin istatistik ve olasılık konusunun öğreniminde yaşanan problemler ve çözüm önerileri [The difficulties in learning the subject of probability and statistics in maths lessons of 6^{th}, 7^{th} and 8^{th} grades in primary school and suggestions on solution]* [Unpublished master thesis]. Afyon Kocatepe Üniversitesi.

Arısoy, B. (2011). *İşbirlikli öğrenme yönteminin ÖTBB ve TOT tekniklerinin 6. Sınıf öğrencilerinin matematik dersi istatistik ve olasılık konusunda akademik başarı, kalıcılık ve sosyal beceri düzeylerine etkisi [The effects of STAD and TGT techniques of cooperative learning on sixth grade students? academic achievement, retention and social skill levels in istatistic and probability subject in mathematics lesson*] [Unpublished master thesis]. Çukurova Üniversitesi.

Aslan, Ü. (2010). *Fostering students' learning of probability therough video game programming* [Unpublished master thesis]. Boğaziçi University.

Ata, A. (2013). *Öğretmen adaylarının olasılık konusuna ilişkin kavramsal ve işlemsel bilgi düzeylerinin incelenmesi [Investigation of prospective teachers' conceptual and procedural knowledge levels n probability]* [Unpublished master thesis]. Eskişehir Osmangazi Üniversitesi.

Atcıoğlu, E. (2019). *Kahramanmaraş Sütçü İmam Üniversitesi'nde istatistik dersi alan öğrencilerin profilinin ve başarılarını etkileyen etmenlerin incelenmesi [Research of the profile and the factors affecting the success of the students taking statistics course at Kahramanmaraş Sütçü İmam University*]. [Unpublished master thesis]. Kahramanmaraş Sütçü İmam Üniversitesi.

Avaroğlu, M. C. (2013). *Olasılık öğretiminde sunum biçimlerine ve yanılgı desteğine göre hazırlanmış yazılımların öğrencilerin akademik başarı, sezgisel düşünme ve öğretim süreci deneyimlerine etkisi [The effect of instructional probability software on academic success, intuitive thinking and learning Experience]*. [Unpublished master thesis]. Çukurova Üniversitesi.

Avcı, E. (2017). *Ortaokul matematik öğretmenlerinin vustat ve tinkerplots yazılımlarının veri işleme öğrenme alanında kullanılabilirliği ile ilgili görüşleri [Middle school teachers' opinions about using vustat and tinkerplots in the learning area of data processing in middle school mathematics]*. [Unpublished master thesis]. Mersin Üniversitesi.

Aydın, Ş. (2020). *Sekizinci sınıf öğrencilerinin merkezi eğilim ölçülerine yönelik istatistiksel düşünmelerinin incelenmesi [An investigation of eighth grade students' statistical thinking about measures of central tendency]*. [Unpublished master thesis]. Hacettepe Üniversitesi.

Bahar, A. (2017). *İlköğretim matematik öğretmen adaylarının olasılık kavramına yönelik bilgi oluşturma süreçlerinin incelenmesi [An investigation of prospective primary mathematics teachers' knowledge construction processes toward probability]*. [Unpublished master thesis]. Dokuz Eylül Üniversitesi.

Bakırcı, S. (2014). *İlköğretim 7.sınıf öğrencilerinin olasılıkla ilgili problem çözme süreçlerinin incelenmesi üzerine nitel bir çalışma [A qualitative study on primary school 7th grade students' probability problem solving process]*. [Unpublished master thesis]. Necmettin Erbakan Üniversitesi.

Balkan, İ. (2013). *Bilgisayar destekli öğretimin, ilköğretim 7. Sınıf öğrencilerinin matematik dersi, 'Tablo ve grafikler' alt öğrenme alanındaki akademik başarılarına ve tutumlarına etkisi [The effect of computer*

assisted instruction on academic achievements and attitudes of seventh-grade students in the field of mathematics 'Charts and Graphics'] [Unpublished master thesis]. Gazi Üniversitesi.

Balkaya, T. (2020). *Ortaokul öğrencilerinin Tinkerplots yazılımı ile istatistiksel modelleme süreçlerinin incelenmesi [The investigation of middle school students' statistical modelling processes with Tinkerplots]* [Unpublished master thesis]. Mersin Üniversitesi.

Batur, A. (2021). *Ortaokul matematik öğretmenlerinin istatistiği öğretme bilgilerinin karakterizasyonu [Characterization of middle school mathematics teachers' statistical knowledge for teaching]* [Unpublished master thesis]. Trabzon Üniversitesi.

Bayrak, S. (2012). *İstatistik dersine yönelik kaygının yapısal eşitlik modellemesi ile incelenmesi [Investigation of anxiety toward statistics course with structural equation modelling]* [Unpublished master thesis]. Uludağ Üniversitesi.

Benibil, O. (2019). *Matematik öğretmen adaylarının olasılık ve istatistik kavramlarına ilişkin bilişsel yapılarının kelime ilişkilendirme testi ile incelenmesi* [The investigation of the cognitive structures of mathematics teacher candidates about the probability and statistics concepts by word correlation test] [Unpublished master thesis]. Necmettin Erbakan Üniversitesi.

Berkün, D. N. (2016). *Permütasyon ve olasılık konusunun öğretiminde bilgi değişme tekniğinin kullanılmasının akademik başarıya ve hatırda tutma düzeyine etkisinin incelenmesi [The effect of exchange of knowledge method on the academic success and recall level in teaching permutation and probability subject]* [Unpublished master thesis]. Anadolu Üniversitesi.

Besler, B. (2009). *8.sınıf matematik dersi permütasyon ve olasılık konusunun öğretiminde yapılandırmacı yaklaşıma uygun olarak hazırlanmış çalışma yapraklarının öğrenci başarısına etkisi [To the students' success the effect of worksheets prepared suitable for the constructivist approach in 8th grade mathematics at teaching of possibility and permutation]* [Unpublished master thesis]. Gazi Üniversitesi.

Bilgin, E. A. (2014). *Temel istatistik konularındaki bir bilgisayar yazılımının öğrencileri başarı ve tutumlarına etkisinin incelenmesi [Investigation of the effects of basic statistics of student achievement and attitude of a computer program in the subject]* [Unpublished master thesis]. Yüzüncü Yıl Üniversitesi.

Boztepe, İ. (2010). *İlköğretim 6.sınıf matematik dersi olasılık konusunda çoklu zeka kuramının öğrenci başarı düzeyine etkisi [The impect of multiple intelligence theory on the student success level with respect to the probability subject on mathematic at 6th grade]* [Unpublished master thesis]. Gazi Üniversitesi.

Bursalı, G. G. (2019). *Ortaokul öğrencilerinin olasılıksal akıl yürütme seviyelerinin incelenmesi [Investigation of probabilistic reasoning levels of secondary school students]* [Unpublished master thesis]. Bartın Üniversitesi.

Cihan, E. (2017). *Gerçekçi matematik eğitiminin olasılık ve istatistik öğrenme alanına ilişkin akademik başarı, motivasyon ve kalıcılık üzerine etkisi* [The effect of realistic mathematics education on achievement, motivation and retention about probability and statistical learning field] [Unpublished master thesis]. Çukurova Üniversitesi.

Comarlı, S. K. (2018). *Ortaokul matematik öğretmenlerinin veri işleme öğrenme alanına ilişkin problem kurma becerilerinin incelenmesi [Examining the problem posing skills of secondary school mathematics teachers regarding data processing learning field]* [Unpublished master thesis]. Bartın Üniversitesi.

Çakmak, Z. (2013). *Sekizinci sınıf öğrencilerinin istatistik konusundaki matematiksel dil becerilerine ilişkin değişkenlerin yapısal eşitlik modeli ile incelenmesi [An investigation of the variables related to 8th grade students' mathematical language skills in statistics through structural equitation model]* [Unpublished master thesis]. Erzincan Üniversitesi.

Çakmak, Z. T. (2014). *İlköğretim 6-8.sınıf matematik öğrencilerinin istatistik ve olasılık öğrenme alanında zorlandıkları kavram ve konuların belirlenmesi [Determining the concepts and subjects 6-8. grade maths students have difficulty in statistics and probability learning]* [Unpublished master thesis]. Abant İzzet Baysal Üniversitesi.

Çatman Aksoy, E. (2018). *An investigation of 7th grade students' statistical literacy about the concepts of average and variation on bar and line graphs* [Unpublished master thesis]. Middle East Technical University.

Çimenci, F. (2016). *Ortaokul 8.sınıf öğrencilerinin matematik dersine yönelik kaygı, tutum ve öz yeterlilik inançlarının grafik okuma ve yorumlama başarısı düzeylerine etkisinin değerlendirilmesi [Assessment of the effects of math anxiety, attitude and self-efficacy beliefs on the 8th grade students' graph reading and interpretations]* [Unpublished master thesis]. Afyon Kocatepe Üniversitesi.

Çubuk, Ş. (2004). *Matematik öğretiminde permütasyon ve olasılık konusunun bilgisayar destekli öğretim materyalleri ile öğretilmesinin öğrenci başarısına etkisi [The effect of teaching permutation and probability in mathematics teaching with computer aided teaching materials on student success]* [Unpublished master thesis]. Marmara Üniversitesi.

Demirci, Ö. (2018). *Matematik öğretmeni adaylarının olasılık konusunda problem kurma becerilerinin gelişiminin incelenmesi [An investigation of the development of pre-service mathematics teachers' problem posing skills in probability]* [Unpublished doctoral dissertation]. Atatürk Üniversitesi.

Dereli, A. (2009). *Sekizinci sınıf öğrencilerinin olasılık konusundaki hataları ve kavram yanılgıları [The mistakes and misconceptions in probability of eighth grade students]* [Unpublished master thesis]. Eskişehir Osmangazi Üniversitesi.

Dinç, S. (2021). *Veri işleme ve olasılık öğrenme alanlarında yapılan lisansüstü tezlerin incelenmesi [Analysis of postgraduate theses in data processing and probability learning areas]* [Unpublished master thesis]. Kocaeli Üniversitesi.

Diri, F. Ü. (2007). *İstatistik dersine yönelik tutumların araştırılması meslek yüksek okul örneği [The analysis of the attitudes towards statistics case of vocational school]* [Unpublished master thesis]. Gazi Üniversitesi.

Doğucu, M. (2009). *The relationship between mathematics teachers' probability approaches and misconceptions* [Unpublished master thesis]. Boğaziçi University.

Doluzengin, B. (2019). *Gerçekçi matematik eğitiminin altıncı sınıf öğrencilerinin istatistiksel düşünme becerilerine, başarı güdülerine ve bilgilerinin kalıcılığına etkisi [The effect of realistic mathematics education on sixth grade students' statistical thinking, achievement motivation and persistence of knowledge]* [Unpublished master thesis]. Pamukkale Üniversitesi.

Dursun, H. (2019). *Meslek lisesi öğrencilerinin istatistiksel problem çözme ve okuryazarlık becerilerinin geliştirilmesi üzerine bir öğretim deneyi [A teaching experiment on the development of statistical problem solving and literacy skills of vocational high school students]* [Unpublished master thesis]. Marmara Üniversitesi.

Efe, M. (2011). *İşbirlikli öğrenme yönteminin, öğrenci takımları başarı bölümleri ve küme destekli bireyselleştirme tekniklerinin ilköğretim 7. sınıf öğrencilerinin matematik dersi istatistik ve olasılık ünitesindeki başarılarına, tutumlarına ve motivasyonlarına etkisi [The effects of cooperative learning method of students? teams- achievement divisions and team assisted individualization instructions on students' attitudes, achievement and motivation at primary 7th grade 'statistics and probability' units on mathematics course*] [Unpublished master thesis]. Mustafa Kemal Üniversitesi.

Ekinözü, İ. (2003). *İlköğretimde permütasyon ve olasılık konusunun dramatizasyon ile öğretiminin başarıya etkisinin incelenmesi [The Effect of teaching permutation and probability at secondary school on success is examine]* [Unpublished master thesis]. Marmara Üniversitesi.

Emmioğlu, E. (2011). *A structural equation model examining the relationships among mathematics achievement, attitudes toward statistics, and statistics outcomes* [Unpublished Doctoral Dissertation]. Middle East Technical University.

Emmungil, L. (2009). Effect of constructed web-supported instruction on achievement related to educational statistics [Unpublished doctoral dissertation]. Middle East Technical University.

Enisoğlu, D. (2014). Seventh grade students' possible solution strategies, errors and misinterpretations regarding the concepts of mean, median and mode given in bar graph representations [Unpublished master thesis]. Middle East Technical University.

Ercan, Ö. (2008). *Çoklu zeka kuramına dayalı öğretim etkinliklerinin 8.sınıf öğrencilerinin matematik dersi permütasyon ve olasılık üniversitesindeki akademik başarılarına etkisi [The effect of education activities based on multiple intelligence theory on the academic achievements of 8th grade students' mathematics lesson 'permutation and probability' unit*] [Unpublished master thesis]. Gazi Üniversitesi.

Erdem, E. (2011). *İlköğretim 7.sınıf öğrencilerinin matematiksel ve olasılıksal muhakeme becerilerinin incelenmesi [An investigation of the seventh grade students' mathematical and probalistic reasoning skills]* [Unpublished master thesis]. Adıyaman Üniversitesi.

Erdoğan, A. F. (2018). *İlköğretim 7.sınıf merkezi eğilim ölçüleri konusunda probleme dayalı öğrenme yaklaşımının öğrencilerin üstü düzey düşünme becerilerine etkisi [The effect of problem based learning approach on students' high level thinking skills in respect of measures of central tendency of 7th grade elementary school]* [Unpublished master thesis]. Erciyes Üniversitesi.

Egin, M. (2010). *Öğrencilerin grafik okuma ve oluşturma becerilerinin fonksiyonel anlamda incelenmesi* [The research of students' abilities about reading and creating graphs in the meaning of function] [Unpublished master thesis]. Marmara Üniversitesi.

Ergül, K. (2019). *9.sınıf öğrencilerinin dijital yetkinliklerinin istatistik dersi kapsamında geliştirilmesi [Developing 9th grade students' digital competencies as apart of statistics lesson]* [Unpublished master thesis]. Yeditepe Üniversitesi.

Eroğlu, E. (2021). *Yedinci sınıf öğrencilerinin merkezi eğilim ölçüleri konusuna ilişkin bilgiyi oluşturma süreçlerinin incelenmesi [Examination of seventh grade students knowledge construction process on the subject of central tendency measures]* [Unpublished master thesis]. Uludağ Üniversitesi.

Ersoy, E. (2013). *Gerçekçi matematik eğitimi destekli öğretim yönteminin 7.sınıf olasılık ve istatistik kazanımlarının öğretiminde öğrenci başarısına etkisi [The effect of teaching method supported with realistic mathematic education on teaching probablity and statistic goals on seventh grade]* [Unpublished master thesis]. Sakarya Üniversitesi.

Ertem, S. (2007). *Veri toplama ve değerlendirme ünitesinin ilköğretim öğrencilerinin bilimsel tutum geliştirmelerine katkı getirecek şekilde yeniden düzenlenmesi [Rearranging the 'data collection and assesment unit' in a way that will enable primary scool pupils to develop scientific attidudes]* [Unpublished doctoral dissertation]. Dokuz Eylül Üniversitesi.

Esen, B. (2009). *Matematik eğitiminde ilköğretim 6.sınıflarda olasılık konusunun öğretiminde bilgisayar destekli eğitimin rolü [The role of computer assisted instruction in the teaching of probability in sixth grade students in mathematics education*] [Unpublished master thesis]. Selçuk Üniversitesi.

Geçim, A. D. (2012). *The effect of creative drama-based instruction on seventh grade students' mathematics achievement in probability concept and their attitudes toward mathematics* [Unpublished master thesis]. Middle East Technical University.

Gökçe, R. (2019). *Ortaokul matematik öğretmenlerinin istatistiksel akıl yürütmeye ilişkin alan ve pedagojik alan bilgilerinin incelenmesi [Examining middle school mathematics teachers' content and pedagogical content knowledge of statistical reasoning]* [Unpublished doctoral dissertation]. Pamukkale Üniversitesi.

Güler, H. K. (2019). *Ortaokul 7.sınıf öğrencilerinin grafik çizme ve grafik verilerini yorumlama süreçlerinin incelenmesi [Investigating 7th grade students' processes of drawing graph and interpreting data in graphs]* [Unpublished master thesis]. Gaziosmanpaşa Üniversitesi.

Gündüz, N. (2014). *İlköğretim matematik öğretmen adaylarının istatistiksel okuryazarlık ile istatistiğe yönelik tutumları arasındaki ilişkinin incelenmesi [An investigation of the relationship between statistical literacy of primary mathematics teachers and their attitudes towards statistics]* [Unpublished master thesis]. Kocaeli Üniversitesi.

Gürakar, N. (2010). *İlköğretim 6-8.sınıf öğrencilerinin istatistik temsil biçimlerini kullanma becerilerinin belirlenmesi [The determination of using skills for statistical representation forms of garde 6-8. level students]* [Unpublished master thesis]. Abant İzzet Baysal Üniversitesi.

Gürel, R. (2016). *Ortaokul matematik öğretmenlerinin merkezi eğilim ve yayılım ölçülerine ilişkin öğretim bilgilerinin incelenmesi [An investigation of middle school mathematics teachers' knowledge for teaching measures of central tendency and variation]* [Unpublished doctoral dissertation]. Hacettepe Üniversitesi.

Hayat, F. (2009). *İlköğretim 8.sınıf öğrencilerinin olasılıkla ilgili kavramsal ve işlemsel bilgi düzeyleri ve kavram yanılgılarının belirlenmesi [The determination of conceptual and procedural knowledge lewel and misconception of elementary education 8th grades students about probability]* [Unpublished master thesis]. Atatürk Üniversitesi.

Hazer, Ö. (2013). *Çoklu zeka destekli işbirliğine dayalı öğrenme yönteminin 6.sınıf öğrencilerinin matematik dersi olasılık ve istatistik konusundaki başarılarına ve performanslarına etkisi [The effects of cooperative learning methods supported by multiple intelligence theory on sixth grade students achievement and performance toward probability and statistics of mathematics course]* [Unpublished master thesis]. Kocaeli Üniversitesi.

Hotmanoğlu, Ç. (2014). *Sekizinci sınıf öğrencilerinin grafik çizme yorumlama ve grafikleri diğer gösterimlerle ilişkilendirme becerilerinin incelenmesi [Examining of 8th grade students' skills on drawing, interpreting of graphs and connecting graphs to other representations]* [Unpublished master thesis]., Karadeniz Teknik Üniversitesi.

İlgün, M. (2013). An investigation of prospective elementary mathematics teachers' probabilistic misconceptions and reasons underlying these misconceptions [Unpublished master thesis]. Middle East Technical University.

Kanak, G. (2016). *Ortaokul 8.sınıf öğrencilerinin olasılık ile ilgili kavramsal bilgilerinin analizi* [The analysis of secondary eighth grade students' conceptual knowledge with probability] [Unpublished master thesis]. Mersin Üniversitesi.

Kapucu, T. (2017). *The effect of computer instruction on eight grade students' permutation-combination-probability achievement and attitudes towards computer assisted instruction* [Unpublished master thesis]. Middle East Technical University.

Karatoprak, R. (2014). *Assessing preservice mathematics teachers' statistical reasoning* [Unpublished master thesis]. Boğaziçi University.

Katrancı, Y. (2010). *Olasılığın temel kuralları bilgisinin yapılandırmacı kurama göre oluşturulması sürecinin incelenmesi [Constuction process analysis of knowledge of probability basic principles according to constuctivist theory]* [Unpublished master thesis]. Uludağ Üniversitesi.

Kavasoğlu, B. E. (2010). *İlköğretim 6,7 ve 8. Sınıf matematik dersinde olasılık konusunun oyuna dayalı öğretiminin öğrenci başarısına etkisi [The effects of game based teaching of probability on the achievement of mathematis lessons students of 6th, 7th, 8th grades]* [Unpublished master thesis]. Gazi Üniversitesi.

Kaya, F. (2017). *İstatistik dersi online uygulama hesaplayıcı [Statistics course online application calculator]* [Unpublished master thesis]. Kahramanmaraş Sütçü İmam Üniversitesi.

Kaynar, Y. (2012). *Yeni ilköğretim 2.kademe matematik öğretim programının istatistik boyutunun incelenmesi [The investigation of the 'statistics' dimension of the new middle school mathematics curriculum]* [Unpublished master thesis]. Afyon Kocatepe Üniversitesi.

Kılıç, M. A. (2020). *Matematik öğretmeni adaylarının olasılık alan bilgilerine yönelik tasarlanan üst bilişsel sorgulamaya dayalı öğrenme ortamı: bir öğretim deneyi [A metacognitive imquiry based learning environment designed for probability content knowledge of preservice mathematics teacher: A teaching experiment]* [Unpublished master thesis]. Bayburt Üniversitesi.

Kınalıoğlu, İ. H. (2012). *İstatistik öğretiminde kullanılan istatistiksel paket programlarının kullanım düzeyinin öğrenci başarısına etkisi [Effect of use levels of statistical software packages used in statistics education to student success]* [Unpublished master thesis]. Selçuk Üniversitesi.

Koparan, T. (2012). *Proje tabanlı öğrenme yaklaşımının öğrencilerin istatistiksel okuryazarlık seviyelerine ve istatistiğe yönelik tutumlarına etkisi [The effect of project based learning approach on the statistical literacy levels and attitude towards statistics of student]* [Unpublished doctoral dissertation] Karadeniz Teknik Üniversitesi.

Kurt, G. (2016). *Technological pedagogical content konwledge (TPACK) development of preservice middle school mathematics teachers in statistics teaching: A microteaching lesson study* [Unpublished doctoral dissertation]. Middle East Technical University.

Laçin, F. (2014). *Kavram haritası ve Vee diyagramının ilköğretim 8.sınıf istatistik ve olasılık konusunda öğrenci başarısına ve tutumuna etkisi [Effect of concept mapping and vee diagram on the achievement and attitude of students in statistics and probability for 8th grade in elementary]* [Unpublished master thesis]. Zirve Üniversitesi.

Mercimek, O. (2013). *Assessment of preservice mathematics teachers' knowledge for teaching statistic*s [Unpublished master thesis]. Middle East Technical University.

Mut, A. İ. (2003). *Investigation of students probabilistic misconceptions* [Unpublished master thesis]. Middle East Technical University.

Okuyucu, M. A. (2019). *Gerçekçi matematik eğitimi yaklaşımının 10.sınıf veri, sayma ve olasılık ünitesinin öğretiminde öğrenci başarısına etkisi ve öğrenci görüşlerinin incelenmesi* [The effect of realistic mathematics education approach on student success in teaching 10 th grade data, counting and probability unit and investigation of student opinions] [Unpublished master thesis]. Yüzüncü Yıl Üniversitesi.

Öcal, M. F. (2014). *Students' intuitively-based misconceptions in probabilty: Teachers' awarenesses and teaching practices in middle and high schools* [Unpublished doctoral dissertation]. Middle East Technical University.

Öz, Ö. (2019). *An investigation of 7th grade students' level of understanding in the statistical investigation process* [Unpublished master thesis]. Middle East Technical University.

Özbay, S. (2012). *İnformal çıkarsamalı akıl yürütme öğrencilerin örneklem hakkındaki akıl yürütme ve düşünme süreçleri [Students' thinking processes and reasoning about sample during informal inferential reasoning]* [Unpublished master thesis]. Pamukkale Üniversitesi.

Özbaykuş, P. (2008). *İlköğretim 6.sınıf matematik dersinden sayılardan olasılığa yansımalar ünitesindeki portfolyo çalışmaları hakkında öğretmen ve öğrenci görüşleri* [Teachers' and students' opinions about portfolio studies in 'reflections from numbers to probability' unit in primary school 6.class mathematics lesson] [Unpublished master thesis]. Gazi Üniversitesi.

Özdemir, G. (2012). *Yapılandırmacı öğretim yaklaşımına uygun olarak hazırlanmış çalışma yapraklarıyla 7.sınıflarda olasılık öğretimi [Teaching of probability by worksheets based on the contructivist approach at the 7th grade]* [Unpublished master thesis]., Atatürk Üniversitesi.

Özdemir, S. (2014). *İstatistik dersinde işbirlikli öğrenmenin öğrencilerin akademikr başarılarına, tutumlarına etkisi ve istatistiksel düşünme seviyelerinin incelenmesi [The effect of cooperative learning in statistics course on the academic success and attitude of the students and analyzing their level of statistical thinking]* [Unpublished master thesis]., Çukurova Üniversitesi.

Özen, M. (2013). *Investigation of pre-service mathematics teachers' critical thinking processes through statistical and probabilistic knowledge in the context of popular media texts* [Unpublished master thesis]. Middle East Technical University.

Özmen, Z. M. (2015). *Farklı lisans programlarında okuyan öğrencilerin istatistik okuryazarlığının incelenmesi* [Examination of the statistical literacy levels of students from different undergraduate programs] [Unpublished doctoral dissertation]. Karadeniz Teknik Üniversitesi.

Öztürk-Zora, L. (2019). *Sekizinci sınıf öğrencilerinin istatistiksel akıl yürütme düzeylerinin incelenmesi* [The investigation of the statistical reasoning levels of 8th grade students] [Unpublished master thesis]., Eskişehir Osmangazi Üniversitesi.

Öztürk, G. (2005). *İlköğretim 8. Sınıf düzeyinde permütasyon ve olasılık ünitesinin bilgisayar destekli öğretim tasarımı [A design of computer assisted instraction of the permutation and probability unit at 8th grade in primary school]* [Unpublished master thesis]. Balıkesir Üniversitesi.

Özyurt, H. (2013). *WEB tabanlı uyarlanabilir test sisteminin geliştirilmesi ve değerlendirilmesi: olasılık ünitesi örneği [The development and evaluation of a web based adaptive testing system: The case of probability unit]* [Unpublished doctoral dissertation]. Karadeniz Teknik Üniversitesi.

Patlar, G. (2019). *Ortaokul matematik öğretmenlerinin alan bilgisi üzerine bir çalışma: araştırma sorusu oluşturma örneği [An investigation on secondary school mathematics teachers' content knowledge: A sample of create research questions]* [Unpublished master thesis]., Necmettin Erbakan Üniversitesi.

Sarıbaş, H. M. (2019). *6,7 ve 8.sınıf öğrencilerinin olasılıksal akıl yürütme düzeylerinin cinsiyet, sınıf seviyesi ve matematiksel başarısı açısından incelenmesi* [*Investigating 6th, 7th and 8th grade students' probabilistic reasoning levels in terms of gender grade level and mathematics achievement]* [Unpublished master thesis]. Hacettepe Üniversitesi.

Selamet, C. S. (2014). *Beşinci sınıf öğrencilerinin tablo ve grafik okuma ve yorumlama başarı düzeylerinin incelenmesi [The examination of reading and interpretation achievement levels of 5th grade students about frequency table and graphs]* [Unpublished master thesis]., Afyon Kocatepe Üniversitesi.

Seyhanlı-Sümersan, S. (2007). *Graf teorisinin ilköğretim 8. Sınıf olasılık konusunun öğretiminde öğrenci başarısına etkisi [The effect on the student achievement of graph theory in teaching of the unit of 'probability' of primary school 8th class]* [Unpublished master thesis]., Balıkesir Üniversitesi.

Sev Lekesiz, E. Ç. (2011). *4.ve 5. Sınıf öğrencilerinin olasılık konusunun öğreniminde karşılaştıkları zorluklar [The difficulties in learning the subject of probability of the fourth and fifth grade students]* [Unpublished master thesis]. Eskişehir Osmangazi Üniversitesi.

Sevim, K. (2019). *Veri işleme öğrenme alanının ortaokul matematik ders kitaplarında işlenişinin öğretim programı açısından değerlendirilmesi [Evaluation of data processing learning domain in middle school mathematics textbooks in therms of curriculum]* [Unpublished master thesis]., Marmara Üniversitesi.

Sevimli, N. E. (2010). *Matematik öğretmen adaylarının istatistik dersi konularındaki kavram yanılgıları; istatistik dersine yönelik öz yeterlilik inançları ve tutumlarının incelenmesi* [Examining pre-service mathematics teachers' misconceptions; self-efficacy beliefs and attitudes towards statistics] [Unpublished master thesis]., Marmara Üniversitesi.

Sevimli, N. E. (2020). *İstatistiksel kavramların teknoloji kullanımıyla öğretimine yönelik tasarlanan bir öğretim modülünün etkililiğinin incelenmesi [Investigating the effectiveness of a teaching module designed for using technology in statistics education]* [Unpublished doctoral dissertation]., Marmara Üniversitesi.

Sezer, N. (2013). *İstatistiğin temel kavramlarının probleme dayalı öğrenme yaklaşımıyla öğretimi [Teaching of statistical basic concepts by the problem-based learning approach]* [Unpublished master thesis]., Uludağ Üniversitesi.

Şafak, C. (2016). *8.sınıf öğrencilerinin olasılık konusundaki kavram yanılgılarının incelenmesi [Examination of 8th grade students' misconceptions about probability]* [Unpublished master thesis]. Abant İzzet Baysal Üniversitesi.

Şahin, F. (2012). *A study development of statistical literacy scale for undergraduate students* (Unpublished master thesis]. Boğaziçi University.

Şan, İ. (2014). *7.sınıf matematik dersi olasılık ve istatistik öğrenme alanının öğretiminde sınav yoluyla öğrenme yönteminin öğrencilerin akademik başarı, tutum ve sınav kaygısına etkisi* [The effect of 'Learning-through-exam method' on students' academic success, attitude and test anxiety in the teaching probability

and statistics learning domain at seventh grade mathematics course] [Unpublished doctoral dissertation]. İnönü Üniversitesi.

Şen, N. (2010). *İlköğretim 6.sınıf matematik dersinde bilgisayar destekli sezgisel düşünme kontrollü olasılık öğretiminin öğrencilerin akademik başarı ve sezgisel düşünme düzeylerine etkisi [The effect of computer-based probability unit designed for the controlling of intuitive thinking on academic success, intuitive thinking and retention]* [Unpublished master thesis]., Çukurova Üniversitesi.

Topan, B. (2019). *Ters-yüz sınıf modeline göre tasarlanan öğrenme ortamının ortaokul öğrencilerinin istatistik okuryazarlık seviyelerine etkisi* [The effect of learning environment based on flipped classroom on statistical literacy levels of middle school students] [Unpublished doctoral dissertation]. Trabzon Üniversitesi.

Tortop, T. (2011). 7th-grade students' typical errors and possible misconceptions in graphs concept before and after the regular mathematics instruction [Unpublished master thesis]. Middle East Technical University.

Tosun, T. (2021). *Ortaokul öğrencilerinin grafik algılarının ve grafik oluşturma yeterliklerinin incelenmesi*[Examining of graph sense and graph construction competences of secondary school students] [Unpublished master thesis]. Adnan Menderes Üniversitesi.

Tuncer, T. (2011). *Matematik dersi yedinci sınıf permütasyon ve olasılık konusunda uygulanan üstbiliş stratejilerinin, öğrencilerin başarılarına, üstbiliş becerilerine, tutumlarına ve kalıcılığa etkisi* [The effect of metacognition strategies applied on seventh grade mathematics subject 'permutation and probability' to the students' metacognition skills, success, attitude and its lastingness] [Unpublished master thesis]. Atatürk Üniversitesi.

Tunç, E. (2006). *Özel ilköğretim okulları ile devlet okullarının 8.sınıf öğrencilerine olasılık konusundaki bilgi ve becerileri kazandırma düzeyinin değerlendirilmesi [Evaluation of acquasition levels of grade 8 students in private and public schools about knowledge and skills in the subject of probability]* [Unpublished master thesis]. Balıkesir Üniversitesi.

Türker-Biber, B. (2017). *İstatistikle ilgili modelleme etkinlikleri bağlamında öğretmen farkındalığı: bir durum çalışması* [Teacher noticing in the context of modelling activities related to statistics: A case study] [Unpublished doctoral dissertation]. Hacettepe Üniversitesi.

Türker, K. N. (2020). *Oyun destekli olasılık öğretiminin 8.sınıf öğrencilerinin olasılıklı düşünmelerine etkisi [The effect of game-based probability teaching on 8th grade students' probability thinking]* [Unpublished master thesis]., Trabzon Üniversitesi.

Uyanık, F. (2007). *Ortaöğretim 10.sınıf öğrencilerinin grafik anlama ve yorumlamaları ile kinematik başarıları arasındaki ilişki* [The correlation between tenth grade students' understanding and interpreting graphs and their kinematics achievement] [Unpublished master thesis]., Balıkesir Üniversitesi.

Ünlü, M. (2008). *İşbirlikli öğretim yönteminin 8.sınıf öğrencilerinin matematik dersi permütasyon ve olasılık konusunda akademik başarı ve kalıcılık düzeylerine etkisi [The effect of cooperative learning method on the academic success and recall levels of 8th grade students in 'permutation and probability' subject]* [Unpublished master thesis]. Gazi Üniversitesi.

Ünlü, V. (2015). *7.sınıf matematik dersi olasılık ve istatistik öğrenme alanında yazma etkinliklerinin öğrenci başarı, tutum ve üst bilişlerine etkisi [The effects of writing activities in the field of 'probability and statistics' on seventh grade math students' achievement, attitudes and metacognition]* [Unpublished master thesis]. Gazi Üniversitesi.

Vural, T. (2020). *An investigation of 8th grade students' statistical literacy through problems with and without context* [Unpublished master thesis]. Middle East Technical University.

Yağcı, F. (2010). *The effect of instruction with concrete models on eighth grade students' probability achievement and attitudes toward probability* [Unpublished master thesis]. Middle East Technical University.

Yeniçırak, Ö. (2020). *Ortaokul matematik öğretmenlerinin veri işleme öğrenme alanına ilişkin öğretme pratikleri: merkezi eğilim ölçüleri [Teaching practices of middle school mathematics teachers regarding data*

processing learning field: Central tendency measures] [Unpublished master thesis]. Trabzon Üniversitesi.

Yenilmez, İ. (2016). *İstatistiksel kavramların teknoloji ile öğretiminin matematik didaktiği perspektifinden incelenmesi [Evaluation of teaching statistical concepts using technology from perspective of didactics of mathematics]* [Unpublished master thesis]. Marmara Üniversitesi.

Yıldırım, İ. (2019). *Hatalı çözüm metodunun 7.sınıf öğrencilerinin bazı istatistik kavramlarındaki başarısı üzerindeki etkisi [The effect of erroneous solution method on the achievement of some statistical concepts of 7th grade students]* [Unpublished master thesis]. Adıyaman Üniversitesi.

Yılmaz, N. (2019). *Öğretmen adaylarının istatistiği öğretme bilgilerinin öğretmenlik uygulaması temelli ders araştırmaları bağlamında incelenmes*i [An investigation of pre-service teachers' statistical knowledge for teaching in a practicum based lesson study] [Unpublished doctoral dissertation]. Hacettepe Üniversitesi.

Yılmaz, S. (2006). *The effects of real data based and calculator supported statistics activities on 7th grade students statistics performance and attitude toward statistics* [Unpublished master thesis]. Middle East Technical University.

Yolcu, A. (2012). *An investigation of eighth grade students statistical literacy, attitudes towards statistics and their relationship* [Unpublished master thesis]. Middle East Technical University.

Yumuk, F. (2019). *Öğrencilerin istatistik dersine karşı tutumlarının psikolojik faktörlerle incelenmesi [Investigation of psychological factors of students against statistical course]* [Unpublished master thesis]., Ondokuz Mayıs Üniversitesi.

Appx.-3 Thesis/Dissertations' codes and types used in the study

Dissertation number	Author	Dissertation types
1	Mut(2003)	Master
2	Ekinözü(2003)	Master
3	Çubuk(2004)	Master
4	Öztürk(2005)	Master
5	Tunç(2006)	Master
6	Yılmaz(2006)	Master
7	Diri(2007)	Master
8	Uyanık(2007)	Master
9	Ertem(2007)	Doctoral
10	Seyhanlı(2007)	Master
11	Ünlü(2008)	Master
12	Ercan(2008)	Master
13	Özbaykuş(2008)	Master
14	Dereli(2009)	Master
15	Besler(2009)	Master
16	Esen(2009)	Master
17	Akkaş(2009)	Master
18	Hayat(2009)	Master
19	Şahin(2009)	Master
20	Emmungil(2009)	Doctoral
21	Doğucu(2009)	Master
22	Kavasoğlu(2010)	Master
23	Alp(2010)	Master
24	Arı(2010)	Master
25	Yağcı(2010)	Master
26	Boztepe(2010)	Master
27	Egin(2010)	Master
28	Şen(2010)	Master
29	Sevimli(2010)	Master
30	Gürakar(2010)	Master
31	Akkaya(2010)	Doctoral
32	Aslan(2010)	Master
33	Katrancı(2010)	Master
34	Arısoy(2011)	Master
35	Sev Lekesiz(2011)	Master
36	Erdem(2011)	Master
37	Emmioğlu(2011)	Doctoral
38	Efe(2011)	Master
39	Tuncer(2011)	Master
40	Tortop(2011)	Master
41	Geçim(2012)	Master
42	Yolcu(2012)	Master
43	Şahin(2012)	Master
44	Özdemir(2012)	Master
45	Kınalıoğlu(2012)	Master
46	Özbay(2012)	Master
47	Bayrak(2012)	Master
48	Koparan(2012)	Doctoral
49	Andiç(2012)	Master
50	Kaynar(2012)	Master
51	Ata(2013)	Master
52	Ersoy(2013)	Master

53	Balkan(2013)	Master
54	Özyurt(2013)	Doctoral
55	Avaroğlu(2013)	Master
56	Özen(2013)	Master
57	İlgün(2013)	Master
58	Sezer(2013)	Master
59	Mercimek(2013)	Master
60	Hazer(2013)	Master
61	Çakmak(2013)	Master
62	Selamet(2014)	Master
63	Hotmanoğlu(2014)	Master
64	Enisoğlu(2014)	Master
65	Bilgin(2014)	Master
66	Laçin(2014)	Master
67	Şan(2014)	Doctoral
68	Öcal(2014)	Doctoral
69	Gündüz(2014)	Master
70	Karatoprak(2014)	Master
71	Özdemir(2014)	Master
72	Bakırcı(2014)	Master
73	Çakmak(2014)	Master
74	Abed(2015)	Master
75	Ünlü(2015)	Master
76	Özmen(2015)	Doctoral
77	Şafak(2016)	Master
78	Selçuk(2016)	Master
79	Berkün(2016)	Master
80	Ateş(2016)	Master
81	Kurt(2016)	Doctoral
82	Kanak(2016)	Master
83	Yenilmez(2016)	Master
84	Gürel(2016)	Doctoral
85	Kapucu(2016)	Master
86	Bahar(2017)	Master
87	Türker Biber(2017)	Doctoral
88	Cihan(2017)	Master
89	Avcı(2017)	Master
90	Kaya(2017)	Master
91	Erdoğan(2018)	Master
92	Çatman Aksoy(2018)	Doctoral
93	Demirci(2018)	Doctoral
94	Çomarlı(2018)	Master
95	Akar(2018)	Master
96	Altınay(2019)	Master
97	Doluzengin(2019)	Master
98	Topan(2019)	Doctoral
99	Atcıoğlu(2019)	Master
100	Yumuk(2019)	Master
101	Bursalı(2019)	Master
102	Patlar(2019)	Master
103	Güler(2019)	Master
104	Sarıbaş(2019)	Master
105	Dursun(2019)	Master
106	Yıldırım(2019)	Master
107	Ergül(2019)	Master

108	Sevim(2019)	Master
109	Zora(2019)	Master
110	Okuyucu(2019)	Master
111	Yılmaz(2019)	Doctoral
112	Benibil(2019)	Master
113	Öz(2019)	Master
114	Gökçe(2019)	Doctoral
115	Türker(2020)	Master
116	Kılıç(2020)	Master
117	Sevimli(2020)	Doctoral
118	Yeniçırak(2020)	Master
119	Aydın(2020)	Master
120	Balkaya(2020)	Master
121	Vural(2020)	Master
122	Altınok(2020)	Master
123	Eroğlu(2021)	Master
124	Tosun(2021)	Master
125	Dinç(2021)	Master
126	Batur(2021)	Master