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Research Article, Review

# The Current State of Turkish STEM Research: A Systematic Review Study

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*Abstract* – In the 21st century, STEM education is gaining importance day by day. In this study, the purpose was to reveal the content analysis of master's thesis and dissertations conducted on STEM education in the field of science education in the last five years in Turkey. A total of 117 theses and dissertations, 18 of which were dissertations and 99 of which were theses, were examined in terms of academic discipline, theoretical frameworks, instructional design models, research designs and models, research areas, statistical analyses, keywords, data collection tools, participants, variables/research focuses and related institutions. In this respect, the present study, which examined the theses and dissertations, is thought to be important with respect to revealing the current situation in the field of science education in Turkey and determining the research trends for researchers.

*Key words*: science, dissertation, thesis, STEM, content analysis

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## Introduction

STEM was formed by combining the initial letters of the concepts of Science, Technology, Engineering and Mathematics. STEM is an educational approach in which individuals identify problems from pre-school to higher education levels with an interdisciplinary approach and which aims to help produce practical and accurate solutions to these problems. This approach prioritizes learning based on research and inquiry by

emphasizing the feelings of curiosity that actually exists in individuals but has become blunt over time. Individuals are expected to transform their knowledge into products and to solve problems by stimulating their sense of curiosity (Altunel, 2018).

The purpose of STEM education is to bring together the disciplines of science, technology, engineering and mathematics. Thus, STEM education aims to train individuals who ask questions, produce solutions with creative thinking and turn solutions into products. It could be stated that STEM education incorporates technology and using technology in education has a positive effect on motivation. Considering the direct contribution of motivation to learning, STEM education could be said to make positive contributions to learning. Another point is that good-quality STEM education can transform students from being passive to being active in lessons. It could be stated that activating students will also stimulate productivity and originality and thus increase students' desire to learn. Another advantage of STEM education is that it supports the transformation of the acquired theoretical knowledge into practice. At the same time, considering the competition on a global scale, it should be emphasized that individuals should be trained in a way to acquire the STEM skills (Eroğlu & Bektaş, 2016). Figure 1 presents the distribution of the numbers of STEM-related studies in the Scopus database by year.

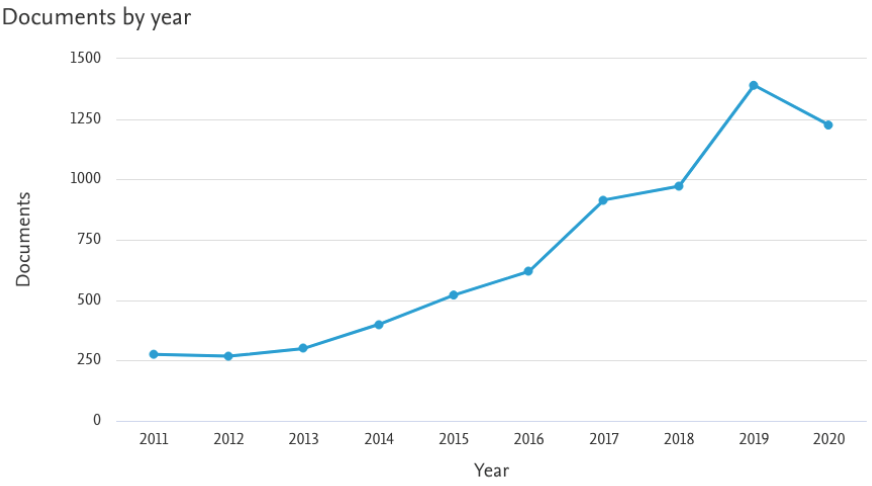



**Figure 1.** The numbers of STEM-related studies by year

According to Figure 1, it could be stated that there has been a tremendous increase in the number of studies conducted in the last 10 years. It was seen that a lot of research was conducted in the field of STEM, especially until 2019.

**Review Studies About STEM**

In the literature, there are many content analysis and meta-analysis studies carried out in the field of STEM. The distribution of the studies between 2016-2020 by year, number of studies and prominent research findings is as follows.

**Table 1.** STEM research in literature

| Author(s) | Highlights of Research Findings | Years | Number of papers |
|---|---|---|---|
| Ormancı (2020) | Mostly preferred method: Mixed method.<br>Mostly preferred data collection tool: Interview form<br>Mostly preferred dependent variable: Academic success<br>Mostly preferred participant type: K-12 students | -2020 | 30 dissertations |
| Josh Brown (2012) | Mostly preferred participant type: K-12 students<br>University with the most studies: Purdue University | 2007-2010 | 60 articles |
| Çevik (2017) | Mostly preferred method: Qualitative method<br>Mostly preferred participant type: Undergraduate students<br>Mostly preferred topics: STEM Evaluation<br>University with the most studies: Gazi University<br>intensely years: 2016 | 2014-2016 | 34 articles |
| Kaleci and Korkmaz (2018) | Mostly preferred method: Qualitative method<br>Mostly preferred participant type: K-12 students<br>Mostly preferred data collection tool: Document analysis<br>Mostly preferred dependent variables: Attitude, precision, perception, attention | 2009-2018 | 40 articles |
| Aydın Günbatar and Tabar (2019) | Mostly preferred method: Qualitative method<br>Mostly preferred participant type: K-12 students<br>Mostly preferred data collection tool: Scale<br>Mostly preferred dependent variables: Attitude and opinion | -2018 | 67 articles |
| Güntaş et al. (2019) | Mostly preferred method: Qualitative method<br>Mostly preferred dependent variable: Attitude | 2009-2018 | 95 articles |
| Zengin et al. (2020) | Mostly preferred data collection tool: Scale<br>Mostly preferred dependent variables: Attitude, perception, belief | 2014-2019 | 40 articles |
| Kaya and Ayar (2020) | Mostly preferred method: Qualitative method<br>Mostly preferred participant type: Teacher<br>Mostly preferred dependent variable: Opinion | 2011-2020 | 50 articles |
| Elmalı and Balkan Kıyıcı (2017) | Mostly preferred method: Qualitative method<br>Mostly preferred data collection tool: Scale<br>Mostly preferred dependent variable: Academic success | 2013-2016 | 50 articles and 5 theses |
| Daşdemir et al. (2018) | Mostly preferred method: Qualitative method<br>Mostly preferred participant type: K-12 students<br>Mostly preferred data collection tool: Tests<br>Universities with the most studies: Gazi University, Middle East Technical University and Yüzüncü Yıl University<br>intensely years: 2017 | 2012-2017 | 32 articles, 13 theses and 6 dissertations |
| Çavaş et al. (2020) | Mostly preferred method: Quantitative method<br>Mostly preferred participant type: K-12 students<br>Mostly preferred data collection tool: Scale<br>Mostly preferred dependent variables: Ability<br>University with the most studies: Kastamonu University<br>intensely years: 2018 | 2010-2018 | 52 articles, 39 theses and 6 dissertations |
| Bozkurt et al. (2019) | Mostly preferred method: Quantitative method<br>Mostly preferred data collection tool: Questionnaire | 2014-2016 | 258 articles |
| Jayarajah et al. (2014) | Mostly preferred method: Qualitative method<br>İntensely years: 2012<br>Mostly preferred participant type: Graduates (University) | 1999-2013 | 57 articles |

| | | | |
|---|---|---|---|
| Göktepe Yıldız and Özdemir (2015) | Mostly preferred method: Quantitative method<br>Mostly preferred participant type: K-12 students<br>İntensely years: 2014 | 2010-2015 | 51 articles |
| Li et al. (2020) | Mostly preferred method: Quantitative method<br>İntensely years: 2018 | 2000-2018 | 798 articles |
| Kartika et al. (2021) | Mostly preferred participant type: K-12 students<br>İntensely years: 2010, 2012, 2014 | 2010-2019 | 86 articles |

When the Table 1 is examined in general, it is seen that only three of the content analysis studies partially examined the dissertations. Most of the content analyses in the table were applied on the articles. In terms of method, qualitative methods were used most in the studies, which was followed by quantitative methods. In the studies examining the data collection tools, it was seen that the most common data collection tool was scale with a rate of 50%, which was followed equally by interview form, document analysis, test and questionnaire. In the studies examining dependent variables, attitude was found as the dependent variable with the highest rate (45%), which was followed by academic success with a rate of 22%. The dependent variables of opinion and ability were equally distributed at 11%. In the studies examining the type of participant, it was seen that the most common type of participant was K-12 students with a rate of 73%. The participant type of K-12 students was followed equally by undergraduate students, teachers and graduates (university) with a rate of 9%.

There are academic studies on STEM education, which has become widespread in Turkey recently. In order for researchers who want to study on STEM to have an idea about the current situation, it is known that there is a need for studies compiling the studies carried out with the content analysis method on STEM with certain features. When the content analysis studies on STEM education were examined, it was seen that there were studies that compiled master's thesis and dissertations. However, it was revealed that there were no content analysis studies on STEM in science education. Therefore, it is thought that in order to overcome this deficiency in the literature, compiling the studies on STEM in science education will provide convenience to researchers who will study on STEM in the field of science education in the future. In this respect, the purpose of this study is to reveal the content analysis of master's thesis and dissertations conducted on STEM education in the field of science education in the last five years in Turkey.

## Method

In this study, a systematic review (Gough et al., 2012) was used to identify the research trends in STEM education. Researchers made use of content analysis (Wilson, 2011). In the study, content analysis was conducted for theses and dissertations in the field of STEM in

science education in Turkey between the years 2016-2020. These theses and dissertations were reached through the National Thesis Center database. The National Thesis Center database is an electronic database which contains all the theses and dissertations conducted in Turkey and which allows researchers to benefit from the permitted theses and dissertations. While reviewing the literature, the following criteria were taken into consideration for the relevant theses and dissertations:

1. Being included in the database of the National Thesis Center,
2. Being conducted between 2016-2020,
3. Being a thesis or dissertation,
4. Having permission to access.

The search for determining the theses and dissertations was done by using the conjunctions of "and" and "or" within the scope of the selected keywords and by choosing the field of Education and Training.

A total of 121 permitted theses and dissertations were reached by using the keywords of "science" and "STEM" or "FETEMM". FETEMM is the Turkish translation of STEM. In addition, four of them were excluded from the scope of the study for various reasons. These reasons included the fact that there were studies not related to STEM and that there were studies not related to STEM in general though STEM was mentioned in their section of literature review. After the thesis and dissertation studies that were not related to the scope of this study were excluded, a total of 117 permitted studies, 18 of which were dissertations and 99 were theses, were reached.

In order to find answers to the research questions, the content analysis method was used and the related theses and dissertations were examined within the scope of various variables. Figure 2 presents the general research flow.

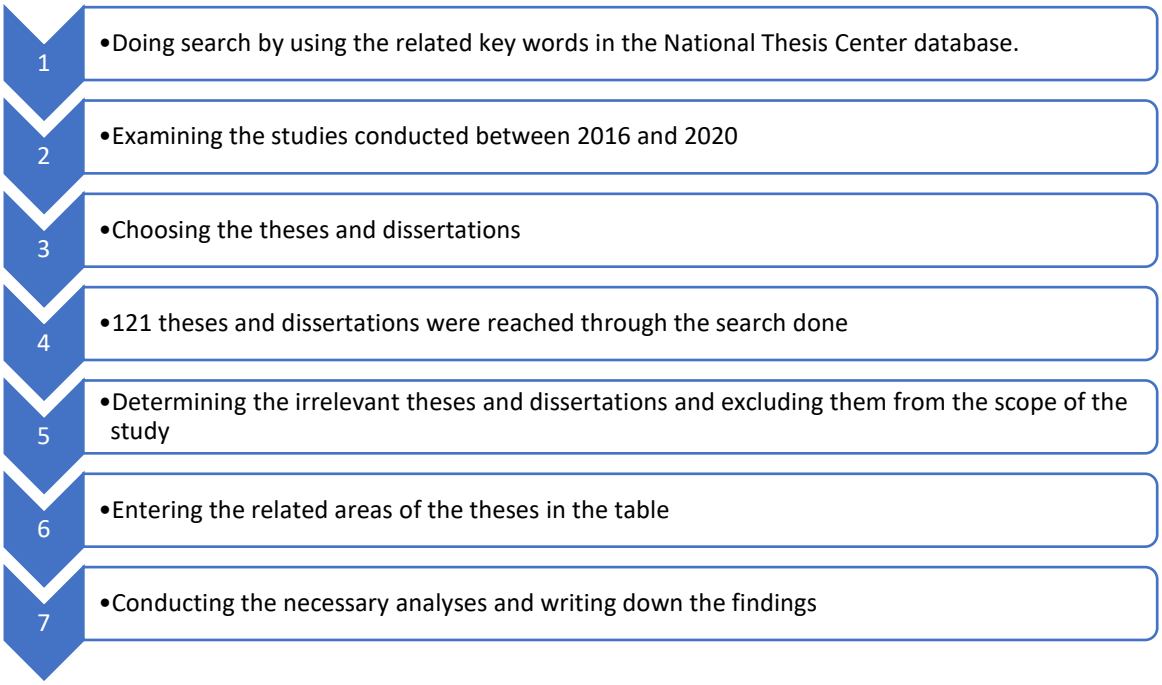



**Figure 2.** Diagram of the research process

*Reliability*

A table was prepared according to the criteria determined with the theses and dissertations reached as a result of the search, and each researcher analyzed the theses and dissertations separately and transferred the results they obtained to their own table. Afterwards, these tables prepared by the researchers were compared, and the differences were identified. Next, the related theses were examined again. A consensus was reached on all the findings, and the content analysis was completed.

## Findings and Discussions

In this part of the study, the results are presented.

*Keywords*

The keywords used in the theses and dissertations within the scope of the study were analyzed. The results obtained are given in Figure 3

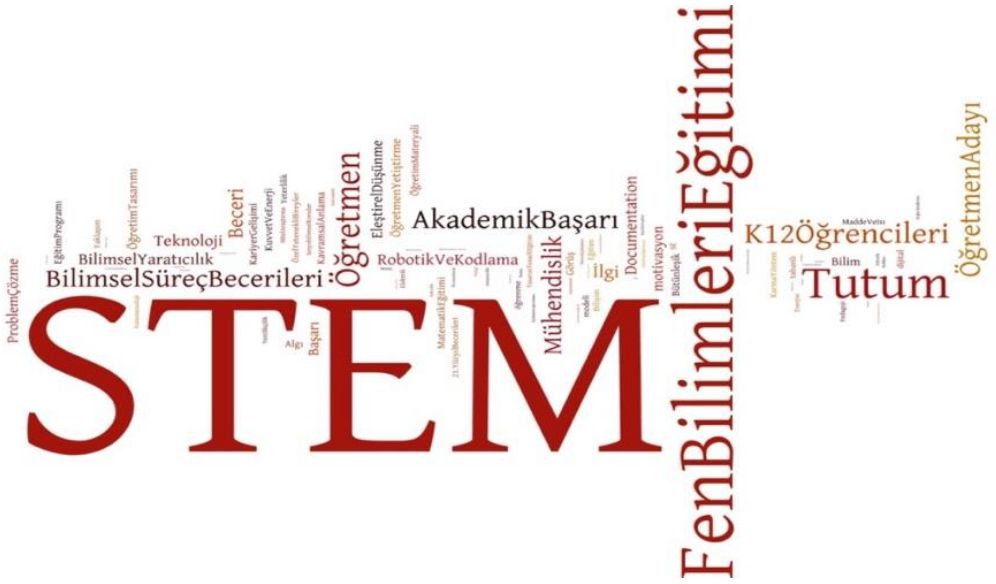



**Figure 3.** Keywords in the theses and dissertations

When Figure 3 was examined, the most frequently used keyword in the theses and dissertations was determined as "STEM", which was followed by the keywords of “Science education (Fen Bilimleri Eğitimi)” , “Attitude (Tutum)”, “K12 students (K12 Öğrencileri)”.

*Academic Discipline*

It was seen that 99 theses and 18 dissertations within the scope of this study were conducted in the field of Education and Training.

*Theoretical/Conceptual Framework*

Among the theses and dissertations examined, only 12 studies were found to be grounded on a theoretical basis. These theoretical foundations were as follows: entrepreneurship, innovation, science education, STEM education. No theory was found in 105 theses and dissertations examined within the scope of the present study.

*Research Design*

The research designs used in the theses and dissertations were discussed in four categories: quantitative, qualitative, mixed and practice-based. The distribution of these categories is given in Figure 4.

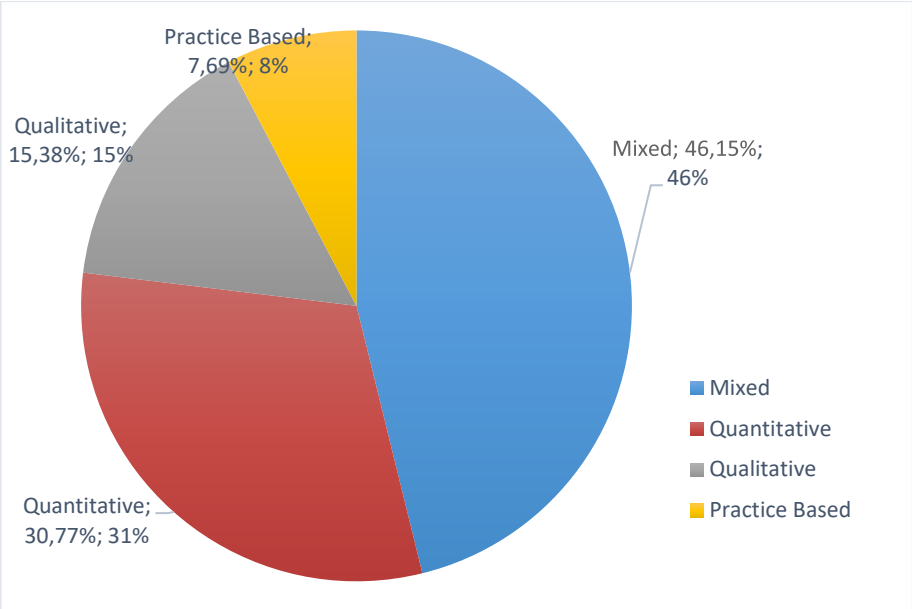



**Figure 4.** Research designs in theses and dissertations

The percentages and frequencies for all the methods are shown in Table 2.

**Table 2.** Distribution of STEM publications by research method and model/design

| Method | F | % | Model/Design | F | % Cum | % Total |
|---|---|---|---|---|---|---|
| Quantitative | 36 | 30,77 | Survey | 7 | 19,44 | 5,98 |
| | | | Correlational | 3 | 8,33 | 2,56 |
| | | | Experimental | 26 | 72,22 | 22,22 |
| | | | Meta analysis | 0 | 0 | 0 |
| | | | Causal comparative | 0 | 0 | 0 |
| Qualitative | 18 | 15,38 | Descriptive | 0 | 0 | 0 |
| | | | Case study | 0 | 0 | 0 |
| | | | Ethnography | 10 | 55,56 | 8,55 |
| | | | Phenomenology | 0 | 0 | 0 |
| | | | Grounded theory | 7 | 38,89 | 5,98 |
| | | | Narrative | 0 | 0 | 0 |
| | | | Content analysis | 0 | 0 | 0 |
| | | | Meta-synthesis | 1 | 5,56 | 0,85 |
| | | | Delphi | 0 | 0 | 0 |
| | | | Historical | 0 | 0 | 0 |
| | | | Heuristic | 0 | 0 | 0 |
| | | | Discourse analysis | 0 | 0 | 0 |
| Mixed | 54 | 46,15 | Explanatory sequential | 7 | 12,96 | 5,98 |
| | | | Exploratory sequential | 0 | 0 | 0 |
| | | | Convergent parallel | 36 | 66,67 | 30,77 |
| | | | Embedded | 10 | 18,52 | 8,55 |
| | | | Multiphase | 0 | 0 | 0 |
| | | | Transformative | 1 | 1,85 | 0,85 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Practice based | 9 | 7,69 | Design based research | 3 | 3,33 | 2,56 |
| | | | Action research | 6 | 66,67 | 5,13 |
| Other / Theoretical / Descriptive | 0 | 0 | Literature review | 0 | 0 | 0 |
| | | | Position paper | 0 | 0 | 0 |
| | | | Opinion paper | 0 | 0 | 0 |
| | | | Report | 0 | 0 | 0 |
| | | | Field notes | 0 | 0 | 0 |
| | | | Comparative | 0 | 0 | 0 |
| | | | Reflection paper | 0 | 0 | 0 |
| | | | Systematic review | 0 | 0 | 0 |
| | | | Technical papers | 0 | 0 | 0 |
| | | | Narrative review=Lit.review | 0 | 0 | 0 |
| Network analytics / Digital / Innovative | 0 | 0 | Log analysis | 0 | 0 | 0 |
| | | | Social network analysis | 0 | 0 | 0 |
| | | | Learning analytics | 0 | 0 | 0 |
| | | | Text (data) mining | 0 | 0 | 0 |
| | | | Internet and traffic ranks | 0 | 0 | 0 |

As a result of the analysis of the data included in the study, among the theses and dissertations conducted in the field of STEM in Turkey between 2016-2020, 47% were carried out with the mixed design (N=54); 31% with the quantitative design (N=36); 15% with the qualitative design (N=17); and 7% were carried with the practice-based design (N=9). The results of the analysis revealed that mixed methods were used more. Ormancı (2020) supports this finding, while Çevik (2017), Keeper and Korkmaz (2018), Aydın-Günbatar and Tabar (2019), Güntaş et al. (2019), Kaya and C.Ayar (2020), Elmalı et al. (2017), Daşdemir et al. (2018) and Jayarajah et al. (2014) concluded that there were more qualitative studies and Çavaş et al. (2020) Bozkurt et al. (2019) Yildiz et al. (2015) and Li et al. (2020) concluded that quantitative methods were used more.

**Table 3.** Research Designs by Year

| **Research design** | 2016 | 2017 | 2018 | 2019 | 2020 | **Total** |
|---|---|---|---|---|---|---|
| Qualitative | 1 | 1 | 4 | 12 | - | **18** |
| Quantitative | - | 4 | 7 | 18 | 7 | **36** |
| Mixed | 2 | 2 | 9 | 29 | 12 | **54** |
| Practice-based | - | 1 | 1 | 6 | 1 | **9** |
| **Total** | **3** | **8** | **21** | **65** | **20** | **117** |

According to Table 3, it could be stated that the number of theses and dissertations increased especially after 2019. A graphical representation of Table 1 is given in Figure 5.

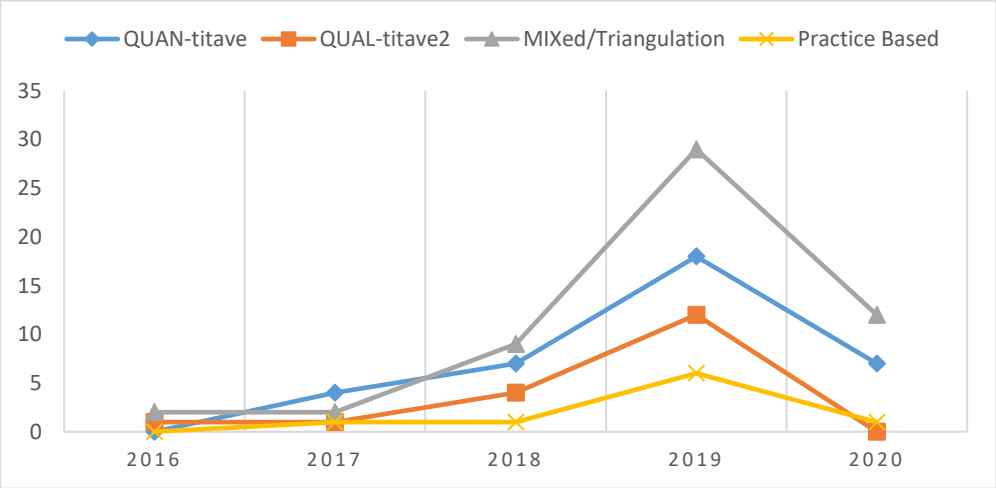
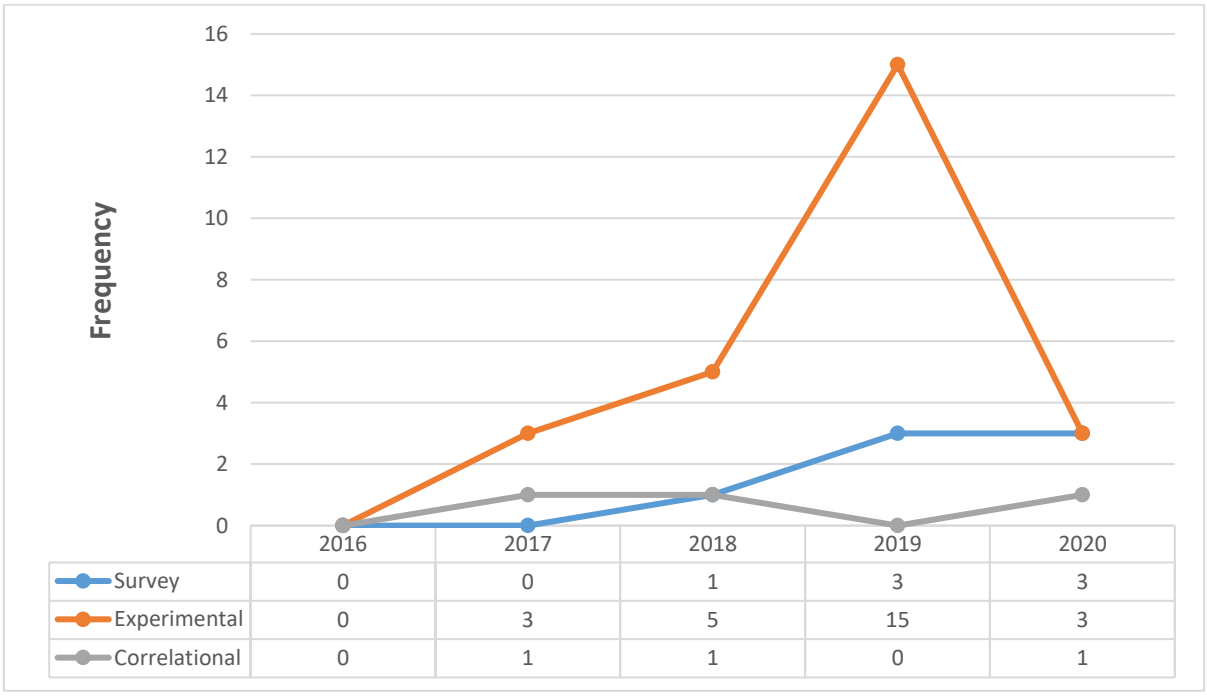



**Figure 5.** Distribution of research designs by years

According to Figure 5, when the distribution of the research designs was examined by year, it was seen that the first study was conducted using a qualitative and mixed design in 2016. In addition, in 2019, there was a remarkable increase in the number of theses and dissertations included in the scope of the present study.

*Research Model*

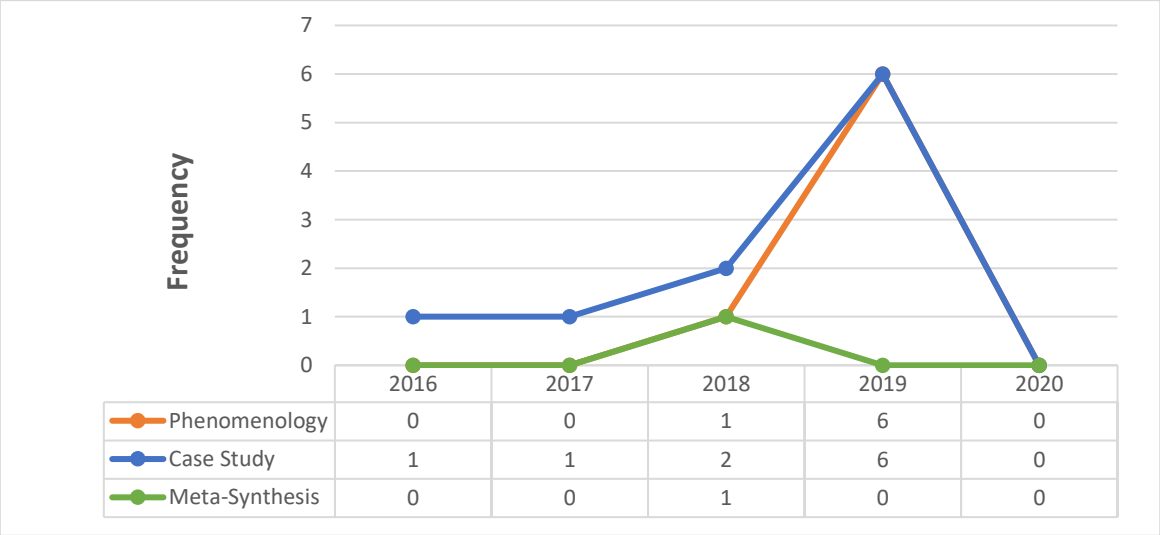
Under this title, the four research models were evaluated within themselves, and the related findings have been presented in comparison with the other findings in the literature.




| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Survey | 0 | 0 | 1 | 3 | 3 |
| Experimental | 0 | 3 | 5 | 15 | 3 |
| Correlational | 0 | 1 | 1 | 0 | 1 |

Figure 6. Distribution of Quantitative Methods by year

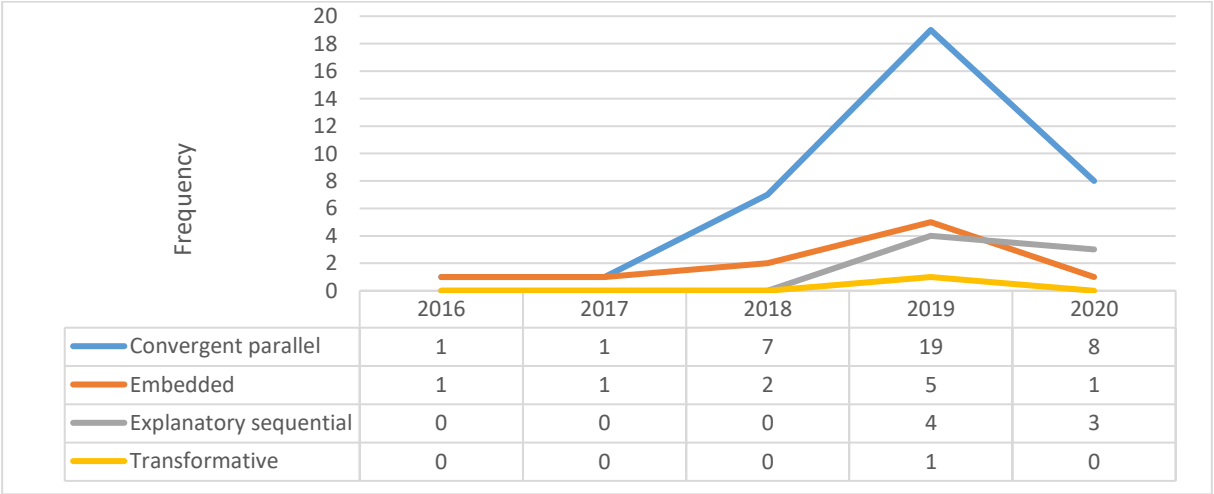
In the theses examined within the scope of the study, it was revealed that the first study with the quantitative method was carried out in 2017. In studies conducted with quantitative methods, the experimental method (N=18) was used most, and the correlational method (N=3) was used least. Çavaş et al. (2020), Bozkurt et al. (2019), Yıldız et al. (2015) and Li et al. (2020) concluded that quantitative methods were used more.




| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Phenomenology | 0 | 0 | 1 | 6 | 0 |
| Case Study | 1 | 1 | 2 | 6 | 0 |
| Meta-Synthesis | 0 | 0 | 1 | 0 | 0 |

Figure 7. Distribution of Qualitative Methods by year

In the theses and dissertations examined within the scope of the study, it was seen that the first study in which qualitative methods were used was carried out in 2016. In studies conducted with qualitative methods, the case study method (N=9) was used most. This finding was supported by Ormancı (2020), while Çevik (2017), Kaleci and Korkmaz (2018), Aydın-Günbatar and Tabar (2019), Güntaş et al. (2019), Kaya and C.Ayar (2020), Elmalı et al. (2017), Daşdemir et al. (2018) and Jayarajah et al. (2014) concluded that qualitative studies were used more.




| | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Convergent parallel | 1 | 1 | 7 | 19 | 8 |
| Embedded | 1 | 1 | 2 | 5 | 1 |
| Explanatory sequential | 0 | 0 | 0 | 4 | 3 |
| Transformative | 0 | 0 | 0 | 1 | 0 |

**Figure 8.** Distribution of Mixed Methods by year

In the theses and dissertations examined within the scope of the study, it was found that the first study using mixed methods was carried out in 2016. Convergent parallel method (N=36) was used most in the studies conducted with mixed methods.

In the theses and dissertations examined within the scope of the study, it was seen that the first study using design-based research methods was carried out in 2017. The convergent parallel method (N=36) was used most in studies conducted with design-based research methods.

Analysis of the findings revealed that the researchers mostly preferred the Mixed research method (46%), which was followed by Quantitative methods (31%), Qualitative methods (16%), and Application-based (8%) methods, respectively. Explanatory sequential design (n = 7), embedded design (n = 10), convergent parallel design (n = 36) and transformative design (n = 1) were used in mixed method studies. Among the quantitative methods, experimental (n = 26), Survey (7%) and Correlation (n=3) research models were used. Qualitative methods (17%) were the third most preferred research paradigm, and in this paradigm, case study (n = 10), Phenomenology (n=7), Metasynthesis (n=1) were the leading research models. Lastly, after the design-based research (n = 3) and action research (n = 6) approaches, the application-based research methods (8%) were found to be the least preferred method.

*Tests and Analysis*

In Table 4, the analysis of the analysis techniques in the theses and dissertations included in the scope of the present study were given as numbers and percentages. According to the data in the table, descriptive statistics were used in 41% of quantitative statistical tests, and inferential statistical methods were used in 59% of them.

**Table 4.** Test and Analysis

| QUANTITATIVE | | | | | |
|---|---|---|---|---|---|
| **Statistical Tests** | | | | | |
| **Descriptive (%41)** | | **Inferential (%59)** | | | |
| | | **Parametric (%45)** | | **Non-Parametric (%14)** | |
| Central Tendency | 39 | t-test | 56 | Chi-square | 3 |
| Relative Standing (Percentage/z-scrore) | 28 | Variance Analysis (Anova/Manova/Mancova) | 20 | Mann Whitney U | 17 |
| Variability (Variance/Standard Deviation/Range) | 26 | Reliability Analysis (Cronbach's Alfa) | 19 | Wilcoxon Test | 16 |
| | | Correlation (Pearson) | 3 | | |
| Descriptive Statistics (Non-Specified) | 23 | Factor Analysis (Confirmatory/Exploratory) | 30 | Kruskal Wallis | 4 |
| | | Regression Analysis | 1 | | |

| QUALITATIVE | |
|---|---|
| Content Analysis | 34 (%100) |
| Thematic Analysis | 0 |

When Table 4 was examined, it was seen that most of the descriptive statistics consisted of central tendency statistics such as mean/median and mode. This was followed by the percentage and z-score values and variability statistics such as variance/standard deviation and range. Most of the inferential statistics included parametric tests. Among the parametric tests, the t-test and factor analysis were the most prominent. When non-parametric tests were examined, it was found that Mann Whitney U and Wilcoxon tests were predominantly used.

*Data Collection Tools*

In Table 5, the analyses of the data collection tools in the theses and dissertations included in the scope of this study were presented as numbers and percentages. According to the data in the table, the most preferred data collection tools were pretest – posttest (n=65), interview (n=60) and scale (n=51), respectively.

**Table 5.** Data Collection Tools

| **Data Collection Tools** | **Frequency** | **Percentage** |
|---|---|---|
| Pre-test / Post-test | 65 | %28 |
| Interview | 60 | %26 |
| Scale | 51 | %22 |
| Questionnaire | 22 | % 1 |
| Observation | 19 | % 8 |
| Documents analysis | 8 | % 3 |
| Recorded audio | 2 | % 8 |
| Focus group | 1 | % 4 |
| **TOTAL** | **228** | **100** |

It was seen that the use of pre-test and post-test as a data collection tool was preferred much more than other data collection tools. These findings were supported by Daşdemir et al. (2018), while Aydın-Günbatar and Tabar (2019), Zengin et al. (2020), Elmalı et al. (2017) and Çavaş et al. (2020) reported that scale, one of the data collection tools, was used more; Bozkurt et al. (2019) concluded that the most used data collection tool was the questionnaire; Ormancı (2020) found that the interview form was the most frequent data collection tool; and Kaleci and Korkmaz (2018) pointed out that the most used data collection tool was document analysis.

*Participants*

In Table 6, the analysis of the participant groups in the theses and dissertations included in the scope of the study was given as numbers and percentages.

**Table 6.** Participants

| Participants | Frequency | Percentage |
|---|---|---|
| K12-Students | 77 | %60 |
| K12-Teachers | 28 | %22 |
| Undergraduate Students | 16 | %12 |
| System/Program | 4 | % 3 |
| K12-Administrators | 1 | % 1 |
| Academicians | 1 | % 1 |
| **TOTAL** | **127** | **100** |

When the data in the table were examined, it was seen that K-12 students (N=77), K-12 teachers (N=28) and undergraduate students (N=16) were in the top three and constituted approximately 98% of all the participants. Accordingly, the sample of K-12 students was preferred more than other samples. These findings were reported by Ormancı (2020), Josh Brown (2012), Kaleci, Korkmaz (2018), Aydın-Günbatar and Tabar (2019), Daşdemir et al. (2018), Çavaş et al. (2020), Yıldız et al. (2015) and Kartika et al. (2021), while Çevik (2017) stated that the most used sample was Undergraduate students. In addition, Kaya, C.Ayar (2020) reported that the most used sample was K-12 teacher, and Jayarajah et al. (2014) concluded that the most used sample was Graduates (University).

*Variables/Research Interests*

The theses and dissertations examined were categorized as dependent variables and listed according to their frequencies as shown in Table 7.

**Table 7.** Variables / research interests

| Variables / research interests | Frequency | Percentage |
|---|---|---|
| Attitude | 42 | %25 |
| Success | 39 | %24 |
| Perception | 22 | %13 |
| Skill | 16 | %10 |
| Motivation | 14 | %9 |
| Opinion | 13 | %8 |
| Attendance | 9 | %5 |
| Self-efficacy | 5 | %3 |
| Effectiveness | 3 | %2 |
| Competence | 2 | %1 |
| **Total** | **165** | **100** |

According to Table 7, "attitude" (25.4%) was used most as a dependent variable in 42 studies. The variable of “attitude” was followed by “success” (23.6%), “perception” (13.3%), “skill” (9.6%) and “motivation” (8.5%) in 39 studies. The data revealed that researchers studied on the dependent variable of attitude more than other variables. These findings were supported by Kaleci and Korkmaz (2018), Aydın-Günbatar and Tabar (2019), Güntaş et al. (2019), Zengin et al. (2020), while Ormancı (2020) and Elmalı et al. (2017) reported that the most researched dependent variable was academic success. In addition, Kaya and C.Ayar (2020) found that the most researched dependent variable was opinion, and Çavaş et al. (2020) concluded that the most researched dependent variable was ability. Lastly, Çevik (2017) pointed out that the most researched topic was STEM evaluation.

*Leading Contributor Institutions*

The universities were ranked from the highest to the lowest number of theses and dissertations, and the top 10 universities in the ranking are given in Figure 9.

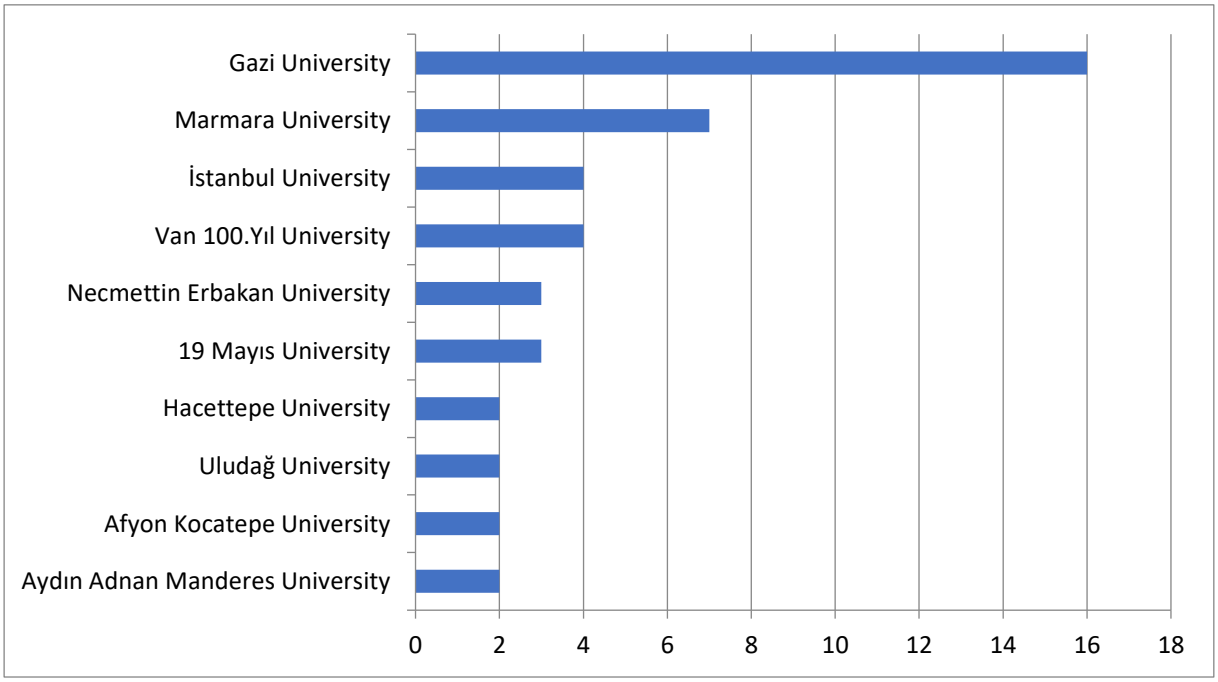



**Figure 9.** Leading Contributor Institutions

It was seen that Gazi University and Marmara University were the leading universities in terms of the number of theses and dissertations in the field of STEM. These two universities were followed by İstanbul University and Van 100.Yıl University. These findings were supported by Çevik (2017) and Daşdemir et al. (2018), while Josh Brown (2012) reported that Purdue University had the highest number of studies. In addition, Çavaş et al. (2020) concluded that the university with the highest number of studies was Kastamonu University.

*Limitations and Strengths*

Within the scope of our study, the database of National Thesis Center was searched, and 121 theses and dissertations with access permission were reached. In addition, four theses and dissertations were excluded from the scope of the study for various reasons such as the fact that there were studies not related to STEM and that there were studies not related to STEM in general though STEM was mentioned in their literature sections. These reasons can be considered as the limitation of our study.

This study revealed the current state of STEM studies in Turkey by examining the theses and dissertations from a multi-dimensional perspective which were conducted in the last five years. It is known that there were studies in this field analyzing the content of theses and dissertations until 2015, but the present study is considered to be important because it is the first study to examine both theses and dissertations after 2015. In addition, it is thought that the findings of the study will make an important contribution to the literature and future studies.

**Conclusions and Suggestions**

In this study, theses and dissertations on STEM studies in science education between 2016-2020 were examined in terms of various variables and research tendencies. It was seen that the theses and dissertations covered in the study were in the field of Education and Training. It was also seen that the keyword of "STEM" was used more frequently than other keywords in the theses and dissertations examined. On the other hand, no keywords were used in two theses and dissertations, and only 12 of the theses and dissertations were based on a theoretical basis.

When the frequency of use of the research design in the theses and dissertations examined was examined, it was seen that the most frequent method was the Mixed method and the least was the practice-based method. When the studies included in the scope of the present study and conducted in the last five years (2016-2020) were examined, it was seen that the designs increased until 2020. The mixed method studies increased more, and this method was preferred more than others. Theses and dissertations on STEM studies in science education were conducted at most in 2019. It was revealed that there was a serious decrease in the studies in 2020. The reason for this decrease could be the Coivd19 pandemic, which broke out in 2020. STEM education is one that requires practice. Conducting STEM studies via distance education will be much more difficult than via face-to-face education. In this respect, it could be thought that the number of theses and dissertations decreased as of 2020. Based on this situation, it should not be thought that the topic of STEM lost its importance. In the studies conducted with the mixed method, it was seen that the convergent parallel method was used most and the

transformative method was used least. However, there was an increase in convergent parallel, embedded, explanatory sequential and Transformative methods in 2019. In the studies conducted with the quantitative method, the experimental method was used most, and the correlational method was used least; in addition, there was a significant increase in the studies carried out with the experimental method in 2019. In studies conducted with the Qualitative method, the case study method was used most, and the Meta-Synthesis method was used least. On the other hand, there was a significant increase in case study and Phenomenology methods in 2019. In the studies carried out with the practice-based design, the Action research method was used most, and the Design-Based research method was least. In addition, the practice-based design was used most in studies in 2019. It was seen that researchers did not use other / theoretical / descriptive, network analytics / digital / innovative methods. In the studies examined, when analyzing the data obtained with the quantitative method, the researchers preferred the Inferential statistical methods more frequently; parametric tests, one of Inferential statistical methods, were used more frequently; and t-test, one of parametric tests, was used more. In addition, when analyzing the data obtained with the Qualitative method, the researchers preferred the content analysis method. This finding was supported by Ormancı (2020), while Çevik (2017), Kaleci and Korkmaz (2018), Aydın-Günbatar and Tabar (2019), Güntaş et al. (2019), Kaya and Ayar (2020), Elmalı et al. (2017), Daşdemir et al. (2018) and Jayarajah et al. (2014) reported that there were more qualitative studies; on the other hand, Çavaş et al. (2020), Bozkurt et al. (2019) Yildiz et al. (2015) and Li et al. (2020) concluded that quantitative methods were used more.

In the studies examined, it was revealed that the use of Pre-test/Post-test as a data collection tool was more frequent than other data collection tools. The data collection tool of Pre-test/Post-test was followed by interview and scale. These findings were supported by Daşdemir et al. (2018), while Aydın-Günbatar and Tabar (2019), Zengin et al. (2020), Elmalı et al. (2017) and Çavaş et al. (2020) reported that the data collection tool of Scale was used more; Bozkurt et al. (2019) concluded that the most used data collection tool was the questionnaire; Ormancı (2020) found that the interview form to be data collection tool used most; and Kaleci and Korkmaz (2018) pointed out that the most used data collection tool was document analysis.

It was seen that the researchers investigated the dependent variable of attitude more than the other dependent variables. The dependent variable of attitude was followed by the dependent variables of success, perception and skill, respectively. These findings were

supported by Kaleci and Korkmaz (2018), Aydın-Günbatar and Tabar (2019), Güntaş et al. (2019) and Zengin et al. (2020), while Ormancı (2020) and Elmalı et al.(2017) reported that the most researched dependent variable was academic success; Kaya, C.Ayar (2020) found that the most researched dependent variable was opinion; Çavaş et al. (2020) concluded that the most researched dependent variable was ability; and Çelik (2017) pointed out that the most researched topic was STEM evaluation.

It was seen that the researchers preferred the K12-students sample group more than the other sample groups. The sample of K12-students was followed by K12-teachers and undergraduate students, respectively. These findings were supported by Ormancı (2020), Josh Brown (2012), Kaleci, Korkmaz (2018), Aydın-Günbatar and Tabar (2019), Daşdemir et al. (2018), Çavaş et al. (2020), Yıldız et al. (2015) and Kartika et al. (2021), while Çelik (2017) reported that the most used sample was Undergraduate students; Kaya, C.Ayar (2020) found that the most used sample was K-12 teachers; and Jayarajah et al. (2014) concluded that the most used sample was Graduates (University).

Gazi University was the one which conducted the highest number of studies on STEM studies in science education. Gazi University was followed by Marmara University, Istanbul University and Van 100.Yıl University, respectively. In addition, the highest number of studies at Gazi University took place in 2019. These findings were supported by Çevik (2017), Daşdemir et al. (2018), while Josh Brown (2012) reported that Purdue University had the highest number of studies. On the other hand, Çavaş et al. (2020) concluded that the university with the highest number of studies was Kastamonu University.

## STEM Araştırmalarında Güncel Eğilimler: Sistematik Tarama Çalışması

**Özet:**

21. yüzyılda, STEM eğitimi her geçen gün önem kazanmaktadır. Bu çalışmada fen bilimleri eğitimi alanında STEM çalışmaları konusunda son 5 yılda yapılmış yüksek lisans ve doktora tezlerinin içerik analizinin ortaya konulması amaçlanmıştır. 18'i doktora 99'u yüksek lisans olmak üzere toplam 117 yüksek lisans ve doktora tezi, akademik disiplin, kuramsal çerçeveler, öğretim tasarım modelleri, araştırma desen ve modelleri, araştırma alanları, istatistiksel analizler, anahtar kelimeler, veri toplama araçları, katılımcılar, değişkenler/araştırma odakları ve ilgili kurumların belirlenmesi amacıyla incelenmiştir. Bu doğrultuda yüksek lisans ve doktora tezlerinin incelendiği bu çalışmanın Türkiye'deki Fen Bilimleri eğitimi alanında STEM çalışmaları konusunda mevcut olan durumun ortaya çıkarılması ve araştırmacılar için araştırma eğilimlerinin belirlenmesi yönünden önemli olduğu düşünülmektedir.

Anahtar kelimeler: fen bilimleri, doktora tezi, tüksek lisans tezi, STEM, içerik analizi.

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