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Content Analysis of Stem-Focused Education Research in Turkey

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ABSTRACT

This study conducted a content analysis for science, technology, engineering and mathematics (STEM)-focused studies in the field of education between 2014 and 2016 in Turkey. "Publication Classification Form" was used to analyze 34 articles identified in this context. The articles were examined by conducting content analysis including identity of the article, its subject, its methodology, its data collection instruments, its sample and data analysis methods. Based on the obtained data, it was determined that the most publications were made by scholars working in institutions such as the Ministry of National Education, Gazi, Sinop, Marmara and Middle East Technical University. It was also found out that qualitative method-based studies were the most prevalent in researches. In the analysis of the data, it was determined that descriptive analyzes were mainly performed, content and descriptive analyzes involving qualitative research methods were extensively used in the studies. It was concluded that analyzing the studies helped researchers make appropriate decisions about the research processes and observe trends in STEM-focused researches.

Keywords: Content analysis, STEM education, STEM research

INTRODUCTION

In this country, developments in all areas have gained a great impetus and developments in science, technology, engineering and mathematics have influenced almost every aspect of modern life. The necessity of integrating the many fields, such as science, technology, engineering, and mathematics, is an expected reflection of this situation to solve several problems we face in the globalizing age (Moore, et al., 2014). Therefore, quests have been initiated to enable individuals to pursue education in this direction (Kizilay, 2016). A new understanding called STEM, comprising the initials of the science, technology, engineering, and mathematics disciplines handled as a whole, has become popular. In this context, the reform efforts undertaken in recent years are shaped by the understanding of STEM, which is a remarkable indication of the importance given to these areas (NAE, 2010 & NRC, 2009).

STEM education is an integrated apporach that embrace creative problem-solving techniques for students who will be innovators of the future (Roberts, 2012). STEM education prepares students to look at problems from an interdisciplinary point of view and gain knowledge and skills (Şahin, Ayar & Adıgüzel, 2014). Those who advocate an integrated

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apporach to STEM education argue that the interests, successes and motivations of the students would be increased with the topics involving real-world problems and ultimately the number of students pursuing careers in STEM fields would be increased (Honey, Pearson & Schweingruber, 2014).

STEM also has strategic priorities in terms of international competitiveness (Corlu, Capraro & Capraro, 2014, 74). Occupations in the STEM field can be considered "future professions" as they are required to drive technological innovation, economic growth, global competition, and the standard of living of a nation (Langdon, McKittrick, Beede, Khan & Doms, 2011, p. 6). The career awareness of students ought to be improved by early intervention in the education system if STEM-focused career choices of students are to be affected (Moore & Richards, 2012; Wyss, Heulskamp & Siebert, 2012). Building and developing an interest in STEM fields is of great importance in terms of students' participations in the workforce in these areas in the future (Knezek, Christensen, Tyler-Wood & Periathiruvadi, 2013).

In this context, STEM, which directly affects the development of countries, has a very important role among the developments in the field of education (Kuenzi, 2008). STEM is regarded as the greatest educational movement of the last decade and support many ongoing educational movements (Daughterly, 2013). STEM education emphasizes a multidisciplinary approach to better prepare students for STEM disciplines and to increase the number of secondary school graduates choosing STEM professions. This indicates that the abbreviation STEM is far more than the naming of the four integrated disciplines (Ostler, 2012). It involves features such as technology-based materials development, visualization, experimentation, and data collection assistance. STEM education in principle seems to be a learning approach that integrates science, technology, engineering, and mathematics disciplines and skills and emphasize student-centered and collaborative learning (Israel, Maynard, & Williamson, 2013).

Thomasian (2011) states that STEM education has two main objectives. The first aims to increase the number of students who would choose a profession in these disciplines at the university level, and the second is to encourage students to apply creative solutions in their everyday lives to solve problems related to these disciplines by increasing the students' level of basic knowledge in science, technology, engineering, and mathematics. Helping students to identify the connections between mathematics and science and occupational options is an important goal of STEM. There are some solutions that can be employed to increase the interest of young students in STEM professions. These are as follows: making projects planning and developing math skills, organizing summer camps or post-school programs to teach science to young people, ensuring the participation of students in mathematics and science clubs, providing opportunities for the exploration of technology, ensuring participation of students in science fairs, spreading the use of internet forums and social networking, and following the profession in science and engineering [State Educational Technology Directors Association (SETDA), 2008]. Experiential learning, practical activities, an integrative STEM education, and creative thinking communities are also possible ways to increase interests of students for STEM professions (Gallant, 2010).

Effective STEM education makes students active in science, technology, engineering, and mathematics applications. It is vital that STEM teachers have the knowledge of STEM, pedagogy, and technological pedagogical content for effective implementation of STEM education (NRC, 2009). These three features enable teachers to disseminate the best teaching of STEM disciplines that students can use in their daily lives and career choices (PCAST, 2010). According to the results of Caleon and Subramaniam's study (2008) with 580 students in grades 5 and 6 in Singapore, 33% of the students were determined to be unsure about choosing science-related occupation. According to this proportion, it is possible to say that the

students do not have enough knowledge to influence their choice of STEM-related professions.

The integration of STEM fields, studied extensively abroad, and education given in schools where goverment policies are being developed in order to raise the workforce is not yet common in Turkey. In this context, there is a need to develop education policies and programs considering the needs of the country under the scope of entrepreneurship (STEM-Entrepreneurship, STEM+E), art/design (STEM-Art, STEAM), and computing (STEM-Computing, STEM+C) (Akgunduz and Ertepinar, 2015).

STEM has a strategic priority to protect our country's international competitive power and the reforms in this area have become especially important for Turkey's economic competition (Corlu, Capraro, & Capraro, 2014). One of the most important elements that will stimulate STEM-oriented educational movements in our country is academic research. In this context, so far, the number, quality, effectiveness and discipline of studies focusing on STEM-based education in our country are of importance. Establishing STEM-focused educational research would help us determine our route.

Educational research is known as the systematic recording, analysis, and publication of data encompassing research processes specific to education and gained through various methods (Mortimore, 2000). These studies have an important role to play in building theoretical foundations and developing policies in the education system. While some of these researches are the basis for educational reforms, others have shed new light with the findings obtained through analyzing previous studies on relevant literature. In this context, examining the existing researches and exploring their quality is of great importance in terms of providing information to researchers (Bacanak, Degirmenci, Karamustafaoglu, & Karamustafaoglu, 2011). Determining trends in the field is also important for the researchers to not only provide new insights but also guide the research processes and compare the results (Tatar & Tatar, 2008). Examining the researches using the content analysis method would be beneficial for the researchers to know the tendencies of the researches in the field, identify the research problems, shed lights on prospective researches, and avoid repetition of studies. In content analysis studies, it is seen that articles are examined mostly in terms of demographic part, research method, topic, and reference characteristics. Bilgin (2006) states that content analysis is employed to make sense of the discourse and avoid subjective factors in interpretation and describes it as a kind of communication psychoanalysis and communication perception art. Bardin (1977) states the content analysis includes the entire communication analyses, and objective and systematic methods are used to describe message contents. Berelson (1952) explains that content analysis is the objective, systematic, and quantitative description of the apparent content of communication.

When the national literature is examined, content analysis studies are found in the fields of education technologies (Gulbahar & Alper, 2009; Küçük et al., 2013), science education (Bacanak et al., 2011; Sozbilir, Kutu, & Yaşar, 2012), biology education (Ozay, Kose, Gul, & Konu, 2014), mathematics education (Baki, Guven, Karataş, Akkan, & Cakiroglu, 2011; Ciltaş, Guler, & Sozbilir, 2010), physics education (Onder et al., 2013), and chemistry education (Sozbilir, Kutu, & Yaşar, 2013; Sozbilir, 2013; Sozbilir, Kutu, & Yaşar, 2011; Sozbilir, Kutu, Yaşar, & Arpacik 2010) that form STEM disciplines. However, no content analysis studies were found for the articles on STEM-focused education in the national field. It is possible to find STEM-focused content analyses in the international literature (Brown, 2012; Jayarajah, Saat, & Abdul Rauf, 2014; Thomas & Watters, 2015; Yildiz Goktepe & Ozdemir, 2015; Jho, Hong, & Song, 2016)

Understanding the content of studies in the relevant literature would accelerate the integration of STEM-focused education. Having an idea about the research demographics, methodology and the topic is an important step in understanding this content. In this context,

relevant articles with the specified criteria were examined using content analysis of qualitative analysis methods and the answers to the following questions were sought.

1. What is the distribution of the identified articles by year and publication language?
2. What is the number of authors of the identified articles and their distribution by institutions they are affiliated with?
3. What is the distibution of the identified articles by the journals?
4. Which discipline was central for STEM in the identified articles?
5. What are the general trends in the research methods of the identified articles?
6. What are the commonly used data collection tools in the identified articles?
7. What ar the commonly used samples and sample size in the identified articles?
8. What are the commonly used data analysis methods in the identified articles?

METHODS

This study is a descriptive content analysis research as it aims to describe STEM-focused published articles in the field of education and identify their trends. Descriptive content analysis is an effort involving a wide range of timeframe to describe and reveal trends and developments in researches in the field (Çalık ve Sözbilir 2014). Falkingham and Reeves (1998) also indicate that content analysis is a new method used for evaluating a collection of publications

a) Survey and Selection Criteria

The articles published in the period 2014–2016 on STEM-focused education studies in Turkey were selected with certain criteria and examined in terms of various variables. For this study indexes and journal databases such as the Educational Resources Information Centre (ERIC), EBSCO, Educational Journals @ ProQuest, Emerald, Science Direct, Scopus TM, Springer Link, Taylor Francis Online, Web of Science, Ulakbim and Google Scholar were searched. These indexes and journal databases were searched using key words such as STEM, STEM education, STEM in Turkey, Fetemm, Fetemm education, Fetemm in Turkey. Required criteria for the articles accessed from the indexes are as follows:

1. Being published in a national/international peer-reviewed indexed journal between 2014 and 2016. As STEM focused educational studies started about in 2014, studies conducted in these dates were included for this study.
2. The fact that study fields of the articles are from Turkey
3. Being STEM-focused research

In total, 34 articles were identified meeting these criteria.

b) Data Collection Tool

The “publication classification form” developed by Sözbilir, Kutu and Yaşar (2013) was used in the present study. A number of changes were made in this form before it was used to classify the articles. The publication classification form consists of six parts: descriptive information about the identity of the article, the topic of the article, method, data collection tools, sample and data analysis methods.

c) Data Analysis

The articles identified by the survey were reviewed in the following subheadings: “publication date,” “number of authors,” “author institution/institutions and department,” “publication language,” “STEM study fields (science, technology, engineering, and mathematics),” “sample of the study,” “sample size,” “method used in the study,” “data collection tools,” and “data analysis methods”. The researcher created a table covering these

sections and sub-dimensions of the sections in order to classify articles. The articles were classified by coding with another researcher who has at least a PhD degree and has taken a course of scientific research in order to increase the reliability of the articles. The related correlation was calculated by coding as 1 if the codes structured by two researchers were consistent and as 0 if they were inconsistent. The Pearson correlation coefficient between these codes was found to be .98, and differing codes were amended through discussion. the articles were analyzed with agreements of researchers. Afterwards, six randomly selected articles were coded by another researcher. It was determined that articles coded by researchers were 100% consistent.

FINDINGS

In this section, In the findings section of the study, analyses of the STEM-focused educational articles with different variables and the findings obtained were presented. In this context, research findings were given in terms of years and publication language, number of authors and distribution by universities, distribution by journals, topic distribution, method used, data collection tool, sample, and data analysis method. The frequency and percentage results were tabulated and interpreted.

Demographic Information Distributions of Researches

A total of 34 articles were identified in accordance with the determined inclusion criteria from STEM-focused educational studies published between 2014 and 2016 in Turkey.

a) Distribution of Studies by Years and Study Language

Distribution of publication years and the study language of the identified articles were shown in Table 1.

Table1. *Distribution of studies by years and frequency and percentages of study language*

	Turkish		English		Total	
	Frequency(f)	Percentage (%)	Frequency(f)	Percentage (%)	Frequency(f)	Percentage (%)
2014	3	8.8	5	14.7	8	23.5
2015	1	2,9	7	20.5	8	23.5
2016	3	8.8	15	44.1	18	53
Total	7	20.5	27	79.4	34	100

On examining Table 1, it is seen that 3 Turkish (8.8%) and 5 English (14.7%) articles in 2014, one Turkish (2.9%) and 8 English (20.5%) articles in 2015 and three Turkish (8.8%) and fifteen English (44.1%) articles in 2016 were published. The highest number of publications was 18 (53%) and 27 (79.4) that were in English.

b) Number of Authors of Studies

The articles were grouped according to the number of authors and the number of researchers for each research was determined. The number of authors is presented in Table 2.

Table 2. *Author numbers of studies*

Number of Author	Article Number(f)	Percentage(%)
1	9	26.5
2	11	32.4
3	9	26.5
4	4	11.7
5	1	2.9
Total	34	100

Table 2 shows that eleven publications (32.4%) had with 2 authors, 9 publications (26.5%) had one author, and 9 publications (26.5%) had 3 authors.

c) Author Institutions of Studies

The distribution information of institutions of autors is given in Table 3.

Table 3. *Author Institutions of Studies*

Universities/Institutions	Frequency (f)	Percentage(%)
Gazi University	7	9.9
MoNE (Ministry of National Education)	7	9.9
Sinop University	6	8.6
Middle East Technical University (METU)	5	7.1
Marmara University	5	7.1
Overseas Universities	4	5.6
Recep Tayyip Erdoğan University	4	5.6
Aksaray University	3	4.2
Karadeniz Techical University (KTU)	3	4.2
Bilkent University	3	4.2
Boğaziçi University	2	2.8
Kafkas University	2	2.8
Muş Alparslan University	2	2.8
Ondokuz Mayıs University	2	2.8
TÜBİTAK	2	2.8
Uludağ University	2	2.8
Erciyes University	1	1.4
Abant İzzet Baysal Üniversity	1	1.4
Anadolu University	1	1.4
Atatürk University	1	1.4
Bahçeşehir University	1	1.4
Giresun University	1	1.4
İstanbul Aydın University	1	1.4
İstanbul Ticaret University	1	1.4
Kocaeli University	1	1.4
Osmangazi University	1	1.4
Pamukkale University	1	1.4
Yüzüncüyıl University	1	1.4
Total	71	100

Table 3 shows that examined large and advanced institutions such as Ministry of Education (MoE) and Gazi University with 7 authors (10%), Sinop University with 6 authors (8.6%), Marmara University and METU with 5 authors (7.1%) are leading.

d) Journals in which articles were published

The distributions of national/international indexted peer-reivewed journals are given in Table 4.

Table 4. *The Distribution of Journals in Which Articles Were Published*

Universities/Institutions	Frequency(f)	Percentage (%)
Journal of Turkish Science Education (TUSED)	5	14.8
International Journal of Education in Mathematics, Science and Technology (IJEMST)	3	8.9
Educational Sciences: Theory & Practice	3	8.9
Eurasian Journal of Educational Research	2	5.9
International Journal of Human Sciences	2	5.9
International Journal of Technology and Design Education	2	5.9
Research Based Activity Journal (RBAJ)	1	2.9
Boğaziçi University Journal of Education	1	2.9
Education and Science	1	2.9
Journal of Theory and Practice in Education	1	2.9
El-Cezeri Journal of Science and Engineering	1	2.9

Eurasia Journal of Mathematics, Science &Technology Education	1	2.9
Gazi University Journal of Gazi Educational Faculty	1	2.9
Gist Education and Learning Research Journal	1	2.9
International Online Journal of Educational Sciences	1	2.9
International Journal of Social Science(JASSS)	1	2.9
Journal of Education in Science, Environment and Health	1	2.9
Journal of STEM Education	1	2.9
Journal of Educational and Instructional Studies in The World	1	2.9
Primary Science	1	2.9
Procedia Social and Behavioral Sciences	1	2.9
Trakya University Journal of Education Faculty	1	2.9
Turkish Journal of Education	1	2.9
Total	34	100

Table 4 shows that that 5 (14.8%) STEM-focused educational studies were published in Journal of Turkish Science Education (TUSED), 3 (8.9%) in each of the International Journal of Education in Mathematics, Science and Technology and Educational Sciences: Theory & Practice, 2(5.9%) in each of International Journal of Human Sciences, Eurasian Journal of Educational Research and International Journal of Technology and Design Education and one (2.9%) in each of the reamining journals.

Topics of Studies

The distribution of study topics in the STEM-focused educational articles are given in Table 5. Besides 4 disciplines in STEM, study titles with keywords such as interest and attitude, tendency, evaluation, opinion and social sciences were also included in the topic distribution.

Table 5. *Distribution of Topics in Studies*

Topic Distributions	Frequency (f)	Percentage (%)
STEM Evaluation	8	23.5
Engineering	6	17.6
Science	5	14.8
STEM Opinion	4	11.8
STEM Tendency	4	11.7
Mathematics	2	5.9
STEM-focused Social Sciences	2	5.9
STEM Interest and Attitude	2	5.9
Technology	1	2.9
Total	34	100

Table 5 shows that STEM evaluations were carried out in 8 publications (23.5%), and STEM studies related to engineering were present in 6 publications (17.6%). Science-oriented studies were in 5 publications (14.8%); STEM tendency and opinion was found in 4 publications (11.7%); mathematics, social sciences-oriented studies, and interest/attitude studies were in 2 publications each (5.9%). Finally, one publication (3.4%) had technology-oriented STEM studies.

Methodology of Studies

Distribution was done by examining the methodologies used in the identified articles in terms of reseach method, data collection tool, sample type and data analysis concepts.

a) Research Method

Research methods used in the identified articles are given in Table 6. These methods were identified as quantitative research, qualitative research and mixed research.

Table 6. *Distribution of Research Method Used in the Studies*

Method of the Article	Frequency (f)	Percentage (%)
Quantitative	11	32.3
Qualitative	20	58.9
Mixed	3	8.8
Total	34	100

Table 6 shows that while 20 (58.9%) of STEM-focused educational studies conducted in Turkey used the qualitative method, quantitative method was used in 11 studies (32.3%). Mixed method was used in 3 publications (8.8%).

b) Data Collection Tool

Data collection tools used in the study were viewed in the form of survey, achievement test, perception, interest, attitude tests, interview-interview, observation and alternative evaluation. The obtained data are given in Table 7.

Table 7. *Distribution of Data Collection Tools Used in the Studies*

Data Collection Tool		Frequency (f)	Percentage (%)
Survey	Likert	10	23.3
Achievement Test	Multiple Choise	2	4.7
Perception, Interest, Altitude etc. Tests		3	6.9
Interview	Semi-structured	4	9.3
	Unstructured	9	21
Observation		1	2.3
Alternative Evaluation	Concept Map	1	2.3
	Document	1	2.3
	Worksheet	2	4.7
	Diaries	1	2.3
	Situation Analysis	3	6.9
	Fenomenography	2	4.7
	Momograraphy	1	2.3
	Field notes	2	4.7
	Case Study	1	2.3
Total		43	100

Table 7 shows that various data collection tools were used in the studies. Likert-type survey in 10 (23.3%), unstructured scale in 9 (21%), and semi-structured scale in 4 (9.3%) and interest/perception/attitude scales in 3 (6.9%).

c) Sample Type and Size

Distribution of the sample type the researchers are working with in their studies is given in Table 8.

Table 8. *Distribution of Sample Type Used in the Studies*

Sample Type	Frequency (f)	Percentage (%)
Undergraduate	16	47.1
Secondary School (5-8)	9	26.5
High School (9-12)	3	8.8
Non-sampling	3	8.8
Primary School (1-4)	2	5.9
Teacher	1	2.9
Total	34	100

Table 8 shows that 16 studies (47.1%) had undergraduate students as the sample, 9 studies (26, 6%) involved secondary school students, 3 studies (8.8%) were non-sampling, 2 studies (5.9%) were with primary school students, and 1 study (2.9%) involved teachers.

Table 9. *Distribution of Sample Size used in the Studies*

Sample Size	Frequency (f)	Percentage (%)
0-10	3	8.8
11-30	8	23.5
31-60	7	20.6
61-100	3	8.8
101-500	6	17.7
>500	4	11.8
Non-Sampling	3	8.8
Total	34	100

Table 9 shows that 8 studies (23.5%) were conducted with 11–30 participants, and 7 researches (20. 6%) involved 31–60 participants; 6 studies (17.7 %) had 101–500 participants, and 4 studies (11.8%) had a large sample of 500. Furthermore, 3 studies (8.8%) were conducted with a range of 0-10 and 61-100 samples. Finally, 3 studies (8.8%) did not involve samples as they used the situation analysis approach.

d) Data Analysis

Data analyzes used in the researches were examined under two main headings as quantitative and qualitative data analysis. Quantitative data analyses were presented into two subheadings descriptively and predictably in Table 10.

Table 10. *Distributions of Data Analysis Used in the Studies*

Data Analysis				Frequency (f)	Percentage (%)
Quantitative Data Analysis		Descriptive	Frequency/Percentage Tables	17	23.6
			Mean/Standard Deviation	8	11.1
			Graphical Demonstration	3	4.2
		Predictive	t-test	6	8.3
			ANOVA/ANCOVA	3	4.2
			Factor Analysis	2	2.8
			Correlation	1	1.4
			Non-Parametric Tests	3	4.2
Qualitative Data Analysis		Qualitative	Content Analysis	10	13.9
			Descriptive Analysis	13	18
			Others	6	8.3
Total				72	100

Table 10 shows that 17 (23.6%) frequency and percentage tables were given in the quantitative data analyses used in the studies. There are also 8 studies (11.1%) in which the mean/standard deviation data have been tabulated. In the qualitative data analysis, 13 (18%) descriptive analysis and 10 (13.9%) content analysis were included. It was determined that t-test as a quantitative data analysis methods was used 6 times (8.3%). While parametric tests for the quantitative data analysis were used 12 times (16.6%) in the studies, non-parametric tests were used 3 times (4.2%). It was determined that Mann–Whitney U Test and Wilcoxon–Signed Rank Test were used from non-parametric tests. Qualitative data analysis was used 29 times (40.3%) in the examined articles.

DISCUSSION and CONCLUSION

A total of 34 articles on STEM-focused educational studies conducted in Turkey between 2014 and 2016 were examined in this study. There is an increase in the number of articles identified by year: 8 articles were published in 2014 and 2015, and 18 articles were published in 2016. Despite a rapid increase in the number of articles in 2016, the actual number is quite low compared to the numbers in the United States, Europe, and the Far East. Akgunduz (2016) reports a decline in the number of students enrolling in STEM disciplines in universities. This present study reveals that there is a shift from STEM disciplines to healthcare areas, indicating that the interest in the STEM disciplines in our country is low and this interest needs to be increased. Akgündüz and Ertepınar (2015) state in the STEM Education Report in Turkey that a numerous studies were conducted in the United States on STEM fields, only few similar studies were conducted in Turkey. They also emphasized the importance of increasing the number of STEM studies conducted in Turkey. There are two STEM-focused theses and a report in the relevant literature that was not included in the study, which could be considered as a limitation of the study. One of the notable contributions of this study to the related literature is that it indicates a need to give importance to STEM-focused articles, theses, reports, and reviews. Of the articles examined in the study, 79.4% were written in English, and 20.5% were written in Turkish. Moreover, it was determined that the vast majority of the studies (85.2%) examined within the scope of the present study had one, two, or three authors. It can be assumed that this situation was caused by the integration of the four disciplines in STEM studies. Furthermore, the quality of the article increases with the number authors since the manuscript would be reviewed and evaluated by various individuals throughout the writing process (Al, 2005). This situation seems to be encompassed in the articles examined in the scope of the research.

It was determined that the majority of the authors are in developed or rapidly developing institutions such as MoE, Gazi, Sinop, Marmara, and METU. In addition, the majority of the journals in which research articles were published were international peer-reviewed journals (79%), and the remaining were national peer-reviewed journals (21%). The most publications were in TUSED, IJEMST, and Educational Sciences: Theory & Practice.

When the study topics of the articles were examined, it was seen that 41.2% articles are based on STEM disciplines. Rest of the articles (58.8%) were conducted on other subjects. STEM-focused studies are a holistic structure involving the joint study of four disciplines. More STEM disciplines are required at the center of the study topics of the articles examined in this study. In particular, the need for experimental studies continues to increase in the recent years in which the theoretical background of STEM education, which should be perceived as holistic, has begun to emerge (Corlu, 2014; Ferrini-Mundy, 2013). In this context, it is necessary to prioritize practical studies that include STEM disciplines in line with the findings and recommendations both in this study and in the relevant literature.

The majority of the methods (58.9%) used in the examined articles was qualitative. Data collection tools such as interviews, observations, worksheets, situation analysis, and filed notes were most frequently used in the qualitative studies. It was observed that the number of studies carried out in qualitative methodology in educational studies in Turkey gradually increased. For instance, Saban et al. (2010) reveal that the number of qualitative studies in educational science increased from 2002 to 2007. The increase in qualitative researches in the field of science education in Turkey has also inherently influenced the STEM-focused education field. This finding is in line with other studies in the relevant literature. When the qualitative studies examined in this study alone are considered, the

finding that content analysis and descriptive analysis methods are employed the most is parallel to that of previous studies (Guven, 2014). It is suggested to include also quantitative methods in STEM-focused studies in line with the results obtained in the study (Bozkurt Altan & Ercan, 2016; Cinar et al., 2016; Ercan et al., 2016).

The most studied sample type in the articles examined is candidate teachers who are studying undergraduate (47.1%). Other samples are students in secondary school (26.5%), high school (8.8%), primary school (5.9%) and teachers (2.9%). This finding indicates that early childhood period was not used as a sample group in STEM-focused studied in Turkey and teachers were rarely selected as a study group. Soylu (2016) reports that STEM-focused education in early childhood did not yet grasp the importance, despite the fact that many researchers proved STEM to be playing a key role in children's scientific skills and their approaches to the science. This explains the reason for the niche of early childhood period in the study.

Sample sizes in the articles were observed as 8 studies (23.5%) with 11–30 participants, followed by 7 studies (20.6) with 31–60 participants. Furthermore, 6 studies (17.7%) had a range of 101–500 participants. While 4 researches (11.8%) were studied with a large sample of 500 participants, 3 studies (8.8%) have a sample size of 0–10 and 61–100. It can be concluded that small samples were preferred mainly by researchers in STEM-focused educational studies. This result is consistent with the findings of Sozbilir, Kutu, and Yaşar (2013). The finding that the number of samples is usually in this range corroborates the finding that the vast majority of the articles use qualitative research patterns.

It is observed that the frequency and percentage tables are most frequently used in the studies examined in the present study. This is parallel to many qualitative research patterns in the study. Furthermore, it was observed that 13 descriptive analyses (18%) and 10 content analyses (13.9%) were most frequently used in the examined articles. Parametric tests such as t-test, analysis of variance/covariance, and multivariate analysis of variance were used less than the other analyses in the examined articles. The use of quantitative data patterns and, in particular, lesser empirical methods in studies has also affected the rate of using this analysis method.

Given all findings of this study, it is considered that emphasizing the importance of focusing on mixed studies in which quantitative data are supported by qualitative data or experimental research which is little used in the field would increase the quality of STEM studies that are carried out by the STEM-focused education researchers in the future. Nevertheless, the main limitations of the investigated articles are that most studies focused on science and mathematics rather than technology and engineering fields. Studies that involve all 4 disciplines in the STEM field ought to be prioritized. This study would help STEM educators and new resarchers, in particular, in their own studies, tracking trends of studies conducted in our country, making appropriate decisions about the study process and reporting their researches.

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