Examination of Postgraduate Theses on STEM Education in Preschool Education in Turkey

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Abstract

This study aimed to examine the postgraduate theses on STEM education in preschool education and to determine the tendencies towards STEM education in preschool education in Turkey. For this purpose, postgraduate theses were reached as a result of the research conducted in the Electronic Thesis Archive of the Council of Higher Education. The study determined that 40 postgraduate thesis studies published between 2018-2022 were examined according to the distribution by years, type, distribution by universities, research models, methods, the profile of the sample group, number of samples, sample selection, data collection tools and subjects. The study used the thematic content analysis method. The research used the "Stem Education Postgraduate Thesis Review Form in Preschool Education" developed by the researchers as a data collection tool. The researchers individually coded the data obtained in the study in the form of general and content characteristics and observed that similar data were obtained in other studies. As a result, the researchers determined that the highest number of theses on STEM education in preschool education was conducted in 2019. The highest number of studies were carried out as master's theses. While most studies were conducted in quantitative models, the studies were generally conducted in quasi-experimental methods. Additionally, the studies used the purposeful (criterion) sampling method to determine the study group. While more studies were conducted with children as the sample group, there were also studies carried out for teachers and prospective teachers. Also, the studies frequently used scales, interview forms and Likert-type questionnaires to collect data. Moreover, the studies mostly focused on the effect of STEM education on scientific process skills, but there were also studies on opinion, perception, tendency and self-efficacy in STEM education.

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Introduction

In the 21st century, due to the rapid development of technology and science, some changes are observed in the education process and the skills desired to be taught to children. Also, the education process has started to be reshaped through different approaches. STEM is an effective approach to gaining the knowledge and skills that students should have at many educational levels. Today, STEM education is applied in formal and informal education environments, from preschool to higher education (Yıldırım, 2021). STEM is an abbreviation consisting of the initials of the words "Science", "Technology", "Engineering", and "Mathematics" (Çakır et al., 2019). STEM is also a process of creating a behaviour change in individuals by associating these disciplines with daily life in an integrated way. Moreover, STEM offers an innovative understanding of learning processes in "Science, Technology, Engineering and Mathematics". It encourages children to use the creativity skills they have developed since birth and directs them to look for alternative solutions in the face of situations and problems they encounter by keeping their sense of curiosity alive (Kartal & Çağlayan, 2018; Yıldırım, 2021). An effective STEM education contributes to developing 21st-century skills, such as the child's critical thinking, problem-solving, and cooperation. It also improves science, mathematics, informatics, media and technology literacy and contributes to the development of Pisa/TIMSS exam results as well as STEM literacy (Karakaya et al., 2018; Kızılay, 2018; Tekerek & Karakaya, 2018). Giving STEM education from the preschool period is important in attracting children's interest in these areas and gaining basic concepts and skills (Ata & Çevik, 2020). In their study, Gonzalez and Freyer (2014) stated that including STEM education from the preschool period supports children in developing a positive attitude towards STEM fields. Children in this period exhibit a positive attitude towards these areas because they are curious, love to research and establish a cause-and-effect relationship (Yıldırım, 2021). Early STEM activities affect many skills, including children's cooperation with each other, gross and fine motor muscle skills, language and early mathematical understanding (Kavak, 2020).

In the literature, there are postgraduate theses investigating the effect of STEM education on children's scientific process skills (Abanoz, 2020; Aydın, 2019; Bal, 2018; Behram, 2019; Çilengir Gültekin, 2019; Kale, 2019; Kavak, 2020; Öcal, 2018; Savaş, 2021), problem-solving skills (Akçay, 2019; Bal, 2018; Deniz Özgök, 2019; Öztürk, 2020) and visual-spatial reasoning skills (Mercan, 2019). The theses also investigated cognitive development (Aydın, 2019), creative thinking skills (Çilengir Gültekin, 2019; Güldemir, 2019, Üret, 2019; Yalçın, 2020), mathematical concept development (Doğan, 2020) and academic self-esteem (Samur, 2022). In addition to these studies, some studies examined the views, perceptions, tendencies and self-efficacy of teachers and prospective teachers who are guides for children in preschool education and offer them many learning opportunities (Çakır, 2022; Erol, 2021; Karamete Gözcü, 2019; Kesicioğlu, 2022; Ramazan, 2021; Sağbaş, 2019; Üspolat Yazıcı, 2021; Yaşar, 2021).

There are also studies on STEM education holistically carried out at many levels of education in Turkey, and detailed information about these studies is presented to the readers. The national literature has experienced an increase in the number of studies on STEM education in Turkey since 2014 (Tezel & Yaman, 2017). Kızılay (2018) examined 13 studies on STEM education in Turkey, while Daşdemir et al., (2018) examined 32 articles and 19 postgraduate theses on STEM education in Turkey. While Püsküllü (2019) examined 33 postgraduate theses published until 2019 from different perspectives, Çavaş et al., (2020) analyzed 45 postgraduate theses and 52 articles on stem education in Turkey. Ceylan (2021) also examined 150 postgraduate thesis studies, including 18 doctoral theses and 132 master's theses. Kahraman et al., (2022) also examined 53 postgraduate theses on STEM education in the last three years in terms of various variables. However, only one study examined the studies on the STEM approach to preschool education. This study was carried out by Avcı (2022) and examined 22 postgraduate theses and 19 research articles published between 2010-2021. Nonetheless, this study examined only two postgraduate thesis studies for 2021, which were stated as the deadline. Despite all these studies, scientific studies on the STEM approach in preschool education are insufficient, and they examined a limited number of postgraduate thesis studies. In light of the findings obtained from the research, it is

important to provide an overview of the studies on the STEM approach in preschool education in our country and to shed light on new studies to be conducted.

This study, examining the postgraduate theses on STEM education in preschool education in Turkey, aimed to determine tendencies towards STEM education in preschool education and to be a source for researchers who are considering working in this field. Within the scope of the purpose of the research, answers to the following questions were sought:

- *What is the distribution of postgraduate studies on STEM education in preschool education in Turkey by years?*
- *What is the distribution of postgraduate studies on STEM education in preschool education in Turkey by study type (master-PhD)?*
- *What is the distribution of postgraduate theses on STEM education in preschool education in Turkey by universities?*
- *What is the distribution of postgraduate theses on STEM education in preschool education in Turkey by research models (patterns)?*
- *What is the distribution of postgraduate theses on STEM education in preschool education in Turkey by research methods?*
- *What is the distribution of postgraduate theses on STEM education in preschool education in Turkey by sampling methods?*
- *What is the distribution of postgraduate theses on STEM education in preschool education in Turkey by sample groups?*
- *What is the distribution of postgraduate theses on STEM education in preschool education in Turkey by the number of samples?*
- *What is the distribution of postgraduate theses on STEM education in preschool education in Turkey by data collection tools?*
- *What is the distribution of postgraduate theses on STEM education in preschool education in Turkey by content?*

Method

Research design

This study conducted to examine the postgraduate theses on STEM education in preschool education in Turkey used the thematic analysis method. Thematic content analysis involves synthesizing and interpreting studies on the same subject with a critical perspective by creating themes or main templates (matrix) (Çalık & Sözbilir, 2014).

Study group

Forty postgraduate thesis studies obtained from the Electronic Thesis Archive of the Council of Higher Education [ETACHE](http://tez.yok.gov.tr/) using the keywords "preschool STEM education", "preschool STEAM education", "STEM education in early childhood", "preschool children and STEM education", "preschool children and STEAM education" constituted the sample of this study. The study was limited to those uploaded to the Electronic Thesis Archive of the Council of Higher Education between 2018 and 2022. There was no thesis study on preschool education in this field in the Electronic Thesis Archive of the Council of Higher Education before 2018. In addition, Annex-1 provides information on the 40 postgraduate theses reached in the archive.

Table 1 provides the codes of the graduate studies included in the study. The studies were first ranked by year of publication. The surnames of the author of the postgraduate study within each publication year were taken into account and placed in alphabetical order and coded "T1, T2, T3, T4, …T40" to be descriptive in the analysis.

Table 1.
Theses and codes for STEM education in preschool education

Thesis	Code	Thesis	Code
Bal (2018)	T1	Kavak (2020)	T21
Başaran (2018)	T2	Öztürk (2020)	T22
Çakır (2018)	T3	Yalçın (2020)	T23

Öcal (2018)	T4	Erol (2021)	T24
Akçay (2019)	T5	Kalyoncu (2021)	T25
Aydın (2019)	T6	Ramazan (2021)	T26
Behram (2019)	T7	Savaş (2021)	T27
Çilengir Gültekin (2019)	T8	Şanlı (2021)	T28
Deniz Özgök (2019)	T9	Tanın (2021)	T29
Güldemir (2019)	T10	Ünlü (2021)	T30
Kale (2019)	T11	Üspolat Yazıcı (2021)	T31
Karamete Gözcü (2019)	T12	Yaşar (2021)	T32
Koç (2019)	T13	Yıldırım (2021)	T33
Mercan (2019)	T14	Bursa (2022)	T34
Sağbaş (2019)	T15	Çakır (2022)	T35
Ünal (2019)	T16	En (2022)	T36
Üret (2019)	T17	Kesicioğlu (2022)	T37
Abanoz (2020)	T18	Samur (2022)	T38
Alan (2020)	T19	Şahiner (2022)	T39
Doğan (2020)	T20	Şimşek (2022)	T40

Data collection tools

This study used the "Stem Education Postgraduate Thesis Review Form in Preschool Education" developed by the researchers to thematically examine the thesis studies on STEM education at the preschool level in the national literature. Three field experts examined the "STEM Education Postgraduate Thesis Examination Form in Preschool Education", and then it took its final version in line with the opinions received. This thesis review form was the form in which recorded the name of the study, the author information, general characteristics (university information, publication year, research type) and content characteristics (model, method, study group/sample, number of samples, sample selection, and data collection tools).

Data analysis

This study reached 40 postgraduate thesis studies by the keywords "preschool STEM education", "preschool education in early childhood", "preschool and children education", and "preschool children and STEAM education" from the Electronic Thesis Archive of the Council of Higher Education (http://tez.yok.gov.tr/). The researchers coded the obtained postgraduate theses by examining the general and content characteristics using the "STEM Education Postgraduate Thesis Review Form in Preschool Education" developed by the researchers. The researchers independently coded theses according to their general and content features by the "STEM Education Postgraduate Thesis Review Form in Preschool Education" in different places and times. As a result, both researchers obtained similar data regarding the studies. Then, the researchers obtained data and codes according to their similarities and created categories. Additionally, they brought together the obtained categories and created themes. In the last stage, the researchers arranged codes, frequencies and themes, and the findings section presents frequency and percentage values.

Findings

This study, examining postgraduate theses on STEM education in preschool education in Turkey, determined the distribution of theses by years, type, universities, research models, methods, sample group, the number of samples, sample selection, data collection tools and content determined. Accordingly, the findings are presented below.

Table 2.
Distribution of theses on STEM education in preschool education by years

Publishing Year	Thesis Code	n

2018	T1, T2, T3, T4	4
2019	T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17	13
2020	T18, T19, T20, T21, T22, T23,	6
2021	T24, T25, T26, T27, T28, T29, T30, T31, T32, T33,	10
2022	T34, T35, T36, T37, T38, T39, T40	7
Total		40

Table 2 shows the numerical and percentage distribution values of the postgraduate theses examined within the scope of the research according to the years they were completed. According to Table 2, (4) postgraduate theses were conducted in 2018, (13) in 2019, (6) in 2020, (10) in 2021, and (7) in 2022.

Table 3.
Distribution of theses on STEM education in preschool education by study type

Study Type	Thesis Code	n
Master's Thesis	T1, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T15, T16, T17, T20, T22, T25, T26, T27, T29, T30, T31, T32, T33, T34, T36, T37, T38, T39, T40	30
PhD Thesis	T2, T13, T14, T18, T19, T21, T23, T24, T28, T35	10
Total		40

Table 3 shows the numerical and percentage distribution values of the postgraduate theses examined within the scope of the research according to the study type. According to Table 3, (30) of the postgraduate theses were master's, and (10) were PhD theses.

Table 4.
Distribution of theses on STEM education in preschool education by universities

University	Thesis Code	n
Aksaray University	T30	1
Alanya Alaaddin Keykubat University	T40	1
Adnan Menderes University	T8	1
Anadolu University	T39	1
Bahcesehir University	T9, T15, T37	3
Balıkesir University	T34	1
Bolu Abant İzzet Baysal University	T16	1
Çukurova University	T21, T23	2
Erciyes University	T13	1
Erzincan Binali Yıldırım University	T3, T35,T38	3
Fırat University	T6, T32	2
Gazi University	T14, T18	2
Gaziantep Üniversitesi	T2	1
Hacettepe University	T19,T28	2
Hasan Kalyoncu University	T20	1
Istanbul Aydin University	T7	1
Kastamonu University	T29, T36	2

Kırklareli University	T26	1
Kütahya Dumlupınar University	T12	1
Manisa Celal Bayar University	T11	1
Marmara University	T1, T25,	2
Pamukkale University	T24	1
Recep Tayyip Erdoğan University	T10, T22	2
Uşak University	T27	1
Üsküdar University	T31	1
Yıldız Technical University	T4, T5, T17, T33	4
Total		40

Table 4 shows the numerical and percentage distribution values of the postgraduate theses examined within the scope of the research according to the universities. According to Table 4, the highest number of theses on STEM education in preschool education was (4) at Yıldız Technical University, while (3) theses were conducted at Bahçeşehir University and Erzincan Binali Yıldırım University.

Table 5.
Distribution of theses on STEM education in preschool education by research models (patterns)

Research Method	Thesis Code	n
Qualitative	T12, T15, T22, T36, T39,	5
Quantitative	T1, T4, T5, T6, T8, T11, T13, T16, T17, T20, T21, T25, T27, T29, T30, T31, T33, T40	18
Mixed	T2, T3, T7, T9, T10, T14, T18, T19, T23, T24, T26, T28, T32, T34, T35, T37, T38,	17
Total		40

Table 5 shows the numerical and percentage distribution values of the postgraduate theses examined within the scope of the research according to their research models (patterns). According to Table 5, (18) studies were conducted in the quantitative model, while (17) studies were conducted in the mixed pattern and (17) studies in the qualitative pattern.

Table 6.
Distribution of theses on STEM education in preschool education by research methods

Research Method		Thesis Code	n
Experimental	Real experimental	T19	1
	Quasi-experimental	T1, T4, T5, T6, T8, T9, T11*, T13, T14, T16, T17, T18, T20, T21, T23*, T24, T25, T26, T27, T28, T29, T30, T33, T34, T40,	25
	Weak Experimental	T3	1
	Not specified	T31	1
Non-experimental	Survey	T11*, T32, T37,	3
Interactive	Action Research	T2, T39,	2
	Case Study	T12, T15, T22, T36, T39,	4
Mixed	Nested Pattern	T7, T23*	2
	Explanatory	T10, T35, T38,	3

* Some theses used more than one research method.

Table 6 shows the numerical values of the postgraduate theses examined within the scope of the research according to the research methods. According to Table 6, the majority of the theses were in the quasi-experimental method (25). The theses examined used case study (4), explanatory (3), screening (3), action research (2), nested pattern (2), action research (2) and weak experimental (1) and real experimental (1) methods. Some of the thesis studies examined (2) used two methods together.

Table 7.
Distributions of theses on STEM education in preschool education by sampling methods

Sampling Method	Thesis Code	n
Purposeful (criterion) sampling	T2, T7, T10, T11, T12, T15, T16, T19, T26, T28, T35, T36, T37, T38	14
Easily accessible(convenient) sampling	T9, T13, T21, T29, T30, T32, T40	7
Simple Random Sampling	T5, T14, T22, T27	4
Random sampling	T18, T23	2
Cluster Sampling	T4, T33	2
Snowball Sampling	T24	1
Not explicitly stated	T1, T3, T6, T8, T17, T20, T25, T31, T34, T39,	10
Total		40

Table 7 shows the numerical and percentage distribution values of the postgraduate theses examined within the scope of the research according to the sampling methods. According to Table 7, most of the theses used the purposeful (criterion) sample (14) method in the sample selection. Among the other sampling methods, easily accessible sampling was used in (7), simple random sampling was used in (4), random sampling was used in (2) , cluster sampling was used in (2), and the snowball sampling was used in (1) thesis study. (10) thesis studies didn't clearly state the sample selection method.

Table 8.
Distribution of theses on STEM education in preschool education by sample groups

Sample Group	Thesis Code	n
Child	T1, T2*, T4, T5, T6, T7, T8, T9, T10*, T13, T14, T16, T17, T18*, T19*, T20, T21, T22*, T23, T25, T27, T28*, T30, T33, T34, T38, T39, T40	28
Preschool Teacher	T2*, T10*, T11, T12, T18*, T19*, T22*, T24, T26, T28*, T31, T32,	12
Prospective Preschool Teacher	T3, T15, T29, T35, T36, T37,	6
Family	T19*, T22*, T28*,	3

*Some theses studied more than one sample group.

Table 8 shows the numerical distribution values of the postgraduate theses examined within the scope of the research according to the sample groups. According to Table 8, most theses on STEM education in preschool education were carried out with children (28), and preschool teachers (12) were the most studied sample group after children. Besides, in the thesis studies examined, (6) studies were conducted for prospective preschool teachers and the

families of the children (3) who participated in the study. Some of the thesis studies examined children and teachers together (6), while a study included children and families in the study group (3).

Table 9.
Distribution of theses on STEM education in preschool education by the number of samples

Sample Number	Thesis Code	n
0-20	T7, T12, T24, T25, T27, T36, T39,	7
21-40	T1, T4, T5, T6, T8, T17, T18, T19, T20, T22, T23, T26, T28, T30, T33, T34, T40	17
41-60	T2, T3, T10, T11, T13, T14, T15, T16, T21, T35, T38,	11
61-100	T9, T29,	2
101 and more	T31, T32, T37,	3
Total		40

Table 9 shows the numerical and percentage distribution values of the postgraduate theses examined within the scope of the research by the number of samples. Table 9 shows (17) theses, with the highest number of samples studied between 21-40. Additionally, the number of samples between 41-60 was (11), the number of samples between 0-20 was (7), the number of samples between 61-100 was (2), and there were (3) studies with 100 or more samples.

Table 10.
Distribution of theses on stem education in preschool education by data collection tools

Data Collection Tool	Thesis Code	n
Interview Forms	T2*, T3*, T7*, T9*, T10*, T12, T14*, T18*, T19*, T22*, T23*, T24*, T26*, T28*, T32*, T35*, T36, T37*, T38*	19
Likert Type Survey	T2*, T7*, T11*, T15, T24*, T26*, T29, T31, T32*, T37*, T38*	11
Scale	T1, T2*, T4, T5, T6, T7, T8, T9, T10*, T13, T14, T16, T17, T18*, T19*, T20, T21, T22*, T23, T25, T27, T28*, T30, T33, T34, T38, T39, T40	30
Video/Photo	T2*, T19*, T39*	3
Observation Form	T14*, T19*,T23*, T28*, T38*	5
Achievement Test	T2	1
Field notes	T2*, T10*, T19*, T22*, T23*, T39*	6

*Some thesis studies used more than one data collection tool.

Table 10 shows the numerical distribution values of the postgraduate theses examined within the scope of the research according to the data collection tools. According to Table 10, most of the theses used scales (30) as a data collection tool. According to the examinations, interview forms were used in (19), Likert type survey in (11), field notes in (6), observation form in (5), video/photo recordings in (3), achievement test in (1) studies. Some of the thesis studies examined within the scope of the research used more than one data collection tool.

Table 11.
Distribution of theses on STEM education in preschool education by content

STEM Education's	Thesis Code	n

Effect on scientific process skill	T1*, T4, T6*, T7, T8*, T11, T16, T18, T19, T21, T25, T27, T33, T34, T39	15
Effect on problem-solving skills	T1*, T3*, T5, T9*, T13, T22, T23*, T28*	8
Effect on creative thinking skills	T3*, T8*, T10, T17, T23*, T28*, T40	7
Effect on reasoning skills	T14	1
Effect on math skills	T20	1
Effect on cognitive thinking	T6*, T9*	2
Effect on critical thinking skills	T40	1
Effect on 21st century skills	T29, T30,	2
Opinion, perception, tendency, and self-efficacy towards STEM education	T2, T12, T15, T24, T26, T31, T32, T35, T36, T37, T38	11

*Some thesis studies used more than one content type.

Table 11 shows the numerical distribution values of the postgraduate theses examined within the scope of the research according to the content. According to Table 11, the effect of stem education on scientific process skills was examined the most (15). Additionally, there was a study on opinion, perception, orientation and self-efficacy towards STEM education (11). In addition, there were studies on STEM education's effect on problem-solving skills (8), effect on creative thinking skills (7), effect on cognitive thinking (2), effect on critical thinking skills (1), effect on reasoning skills (1), and effect on math skills (1).

Discussion and Conclusion

This study examined the postgraduate theses on STEM education in preschool education in Turkey and tried to reveal tendencies towards STEM education in preschool education. The study determined that 40 postgraduate thesis studies published between 2018-2022 were examined according to the distribution by years, type, universities, research models, methods, sample group, the number of samples, sample selection, data collection tools and contents.

The research examined the distribution of theses on STEM education in preschool education by years. According to the examinations, most studies on STEM education in preschool education were conducted in 2019. In their study, Kahraman et al., (2022) examined 53 postgraduate theses in the field of STEM education in terms of various variables and determined 2020 as the year in which most theses were published. Ceylan (2021) examined 150 postgraduate theses, and according to his examination, the highest number of theses was in 2019 and continued to increase over the years. Çavaş et al., (2020) analyzed 45 postgraduate theses and 52 articles on STEM education in Turkey. According to the analysis, most studies were conducted in 2018, and there were increases in the number of studies. According to the study conducted by Avcı (2022), 22 postgraduate theses and 19 research articles were examined between 2010-2021. The study determined that most thesis studies were carried out in 2019. Also, according to the examinations of the distribution of the theses, most studies were carried out in 2020. Yılmaz and Çepni (2019) examined 50 articles and 6 theses on STEM education at the preschool level as content. According to the review, the highest number of studies took place in 2017, and there was an increase in the number of studies over the years. The number of studies on STEM education has increased, and new studies have been added to the field of STEM education over the years.

Secondly, the researchers examined the distribution of theses on STEM education in preschool education by study types. According to the examinations, studies on STEM education in preschool education were more frequently included in master's theses. Yılmaz and Çepni (2019) stated that master's theses were more common among the theses published in their study. Also, the number of master's theses was higher among the theses examined by Çavaş et al., (2020). Similarly, the study

conducted by Ceylan (2021) and Avcı (2022) observed that the studies on STEM education were carried out mainly as a master's thesis study. This study showed that studies on STEM education in preschool education were similar to the other studies in terms of taking place more in master's theses.

The study, examining the distribution of theses on STEM education in preschool education by universities, determined that the highest number of studies were carried out at Yıldız Technical University. The study conducted by Çavaş et al., (2020) on the status of research on STEM education in Turkey observed that the highest number of theses were conducted at Kastamonu University and Middle East Technical University. Also, the study by Ceylan (2021) determined that Gazi University was the university where the thesis was written the most. Moreover, the study conducted by Avcı (2022) determined that Yıldız Technical University was the university where the most theses were published. This study showed that the theses on STEM education in preschool education were similar to the study of Avcı (2022) in terms of their distribution by universities.

Additionally, the study examining when the distribution of theses on stem education in preschool education according to research models (patterns) revealed that the studies were mostly quantitative and mixed patterns. In their study, Yılmaz and Çepni (2019) revealed that more qualitative methods were used in the theses and articles examined. Also, the study conducted by Çavaş et al., (2020) observed that the quantitative method was mainly used in the studies they examined. In his study, Ceylan (2021) listed the order of concentration of the method used in the theses as a mixed, quantitative and qualitative method. Besides, in his study, Avcı (2022) listed the order of concentration of the method used in the theses as quantitative, mixed and qualitative. In addition, some studies did not clearly state the method used in some of the thesis studies. The study by Kahraman et al., (2022) examined the postgraduate theses conducted in the last three years and determined that the mixed pattern was used more. This study revealed that some studies (Çavaş et al., 2020; Ceylan, 2021; Avcı, 2022; Kahraman et al., 2022) were similar in terms of determining the use of quantitative and mixed patterns as research patterns in postgraduate theses. However, the study of Yılmaz and Çepni (2019) differed from the data obtained as a result of the study. The mixed method may be preferred more in terms of using both the positive aspects of the quantitative and qualitative methods.

Moreover, the researchers examined the distribution of theses on STEM education in preschool education by research methods. According to the examinations, the semi-experimental method was used the most in theses. The theses mostly used a case study, explanatory, screening, action research, nested pattern, action research, weak experimental and real experimental methods. Some of the thesis studies examined (f:2) used two methods together. In addition, Çavaş et al., (2020) stated that experimental design and case study were mainly used in their studies. Besides, the method was not clearly stated in the three studies examined. In his study, Ceylan (2021) stated that all the theses in the qualitative research design were conducted in the form of case study action research, one of the interactive methods. Moreover, the thesis used relational screening, descriptive screening and comparative methods among the quantitative methods. The study of Kahraman et al., (2022) examined the postgraduate theses conducted in the last three years and observed that the majority of them were carried out with a screening pattern. This study was similar to the results from some studies using the most experimental method obtained from examining the postgraduate theses on STEM education in the preschool period (Çavaş et al., 2020). However, it differed in terms of the results obtained from other studies (Ceylan, 2021; Kahraman et al., 2022).

Additionally, the researchers examined the distribution of theses on STEM education in preschool education by sampling methods. According to the examination, most of the thesis used the purposive (criterion) sampling method. In addition, the sampling method was not clearly stated in 10 of the 40 theses examined in the study. It was also noteworthy that the sample selection was not clearly stated in the theses examined within the scope of the study conducted by Avcı (2022). Besides, 4 of the 22 theses examined did not clearly state the sample selection. Furthermore, the random sampling method was also the most commonly used sample selection. The sampling method obtained in this study was similar to the other study in terms of not being clearly stated. This

may be because researchers did not have enough knowledge about scientific research.

Besides, the research examined the distribution of theses on STEM education in preschool education by sampling groups. According to the examination, most of the theses were conducted with children and the most studied sample group after children was preschool teachers. In addition, some theses were carried out for prospective preschool teachers and the families of the children participating in some studies. Among the thesis studies examined, there were studies in which children and teachers, children and families were included in the study group. Yılmaz and Çepni (2019) stated that preschool children were mostly the study group in the theses and articles examined in their studies. In addition, there were studies carried out with preschool teachers, parents and prospective teachers. Also, the number of studies carried out with prospective teachers was the least. The study by Çavaş et al., (2020) observed that the students were mostly studied as the sample group in the studies examined. In these studies conducted with students, mostly secondary school students were worked with, while preschool children were worked with at least. Additionally, the studies examined by Ceylan (2021) observed that 5-8th grade students were more included in the study group. Besides, teachers, prospective teachers, administrators and documents were included in the study groups. The study examined 150 studies and 10 studies, including preschool children as a study group. In the theses examined within the scope of the study conducted by Avcı (2022), preschool children were frequently studied, and teachers followed this group. In addition, in the articles, preschool teacher candidates followed preschool children. The study conducted by Kahraman et al., (2022) observed that the majority of the studies were conducted with students, and teachers were the most studied sample group after the students. In the thesis studies examined within the scope of this study, the study group was similar to other studies in terms of being predominantly preschool children. This may be because children, the most important and central of the preschool period, are seen as stakeholders. For this reason, the results obtained with this study group will contribute more to the field. Also, the diversification of the sample group in the studies will contribute to expanding the STEM education field and strengthen the research data.

Besides, the researchers examined the distribution of theses on STEM education in preschool education by the number of samples. According to the examination, the highest number of samples studied was between 21-40. The study where Yılmaz and Çepni (2019) examined the studies on STEM education at the preschool level showed that most of the studies included between 0-10 people, sample groups including 101-200 people, and more were studied less. This study showed similarities in terms of the small number of study groups.

Moreover, the researchers examined the distribution of theses on STEM education in preschool education by data collection tools. According to the examination, scales were mostly used as data collection tools. Also, the scales were followed by interview forms, Likert-type questionnaires, field notes, observation forms, video/photo recordings and achievement tests, respectively. In their research, Yılmaz and Çepni (2019) found that the observation and interview forms were used the most in the theses and articles they examined. They were followed by data collection tools such as achievement tests and questionnaires. The study conducted by Çavaş et al., (2020) determined that scales were the most commonly used data collection tool in the studies examined, and success tests followed them. Semi-structured interviews and observation forms were mostly used among other measurement tools. The studies examined by Ceylan (2021) observed that Likert-type questionnaires, achievement tests and semi-structured interview forms were used more as data collection tools. Besides, the study conducted by Kahraman et al., (2022) revealed that a semi-structured interview form was used as the data collection tool in the majority of the studies. In the theses examined within the scope of the study conducted by Avcı (2022), the scales were mostly used as data collection tools and semi-structured interview forms were used. This finding was similar to other studies in the literature in terms of more use of scales and frequent use of interview forms. According to the examinations, semi-structured interview forms were used as data collection tools in the majority of the studies conducted in the qualitative design. In the studies conducted in the mixed design, qualitative and quantitative data collection tools, which provide an advantage in qualitative and quantitative design, were used together.

Furthermore, the research examined the distribution of theses on STEM education in preschool education by contents. According to the examination, the theses examining the effect of STEM education on scientific process skills were predominant. There were also numerous studies on opinions, perceptions, tendencies, and self-efficacy regarding stem education. Similarly, the study conducted by Ceylan (2021) observed that the number of studies examining the effect of STEM teaching on areas such as skills and success was higher, and the number of studies examining perceptions, tendencies and opinions about the field of STEM was higher. Another study by Avcı (2022) observed that the number of studies examining the effect of postgraduate theses on STEM approaches on problem-solving, creativity, scientific process and cognitive thinking skills was higher. The same study determined that the number of studies examining perceptions and opinions about the STEM field was higher in the articles. This study examining the postgraduate theses on stem education showed that the results obtained from other studies were similar in examining the effect of STEM education on various skills. As a result, this study, examining postgraduate thesis studies on STEM education in preschool education in Turkey, determined that the highest number of thesis studies were conducted in 2019, and the studies were mostly carried out as master's theses. While the research was mostly conducted in the form of quantitative models, there were also studies which frequently used the mixed method. Additionally, some studies were conducted as a quasi-experimental method, but the purposeful (criterion) sampling method was used to determine the study group. The studies conducted with children were more common as the sample group, and there were also studies carried out with teachers and prospective teachers. Also, the studies frequently used scales, interview forms, and Likert-type questionnaires to collect data. Moreover, the studies mostly focused on the effect of STEM education on scientific process skills, but there were also studies on opinion, perception, tendency and self-efficacy in STEM education.

Recommendations

The following suggestions can be presented in light of the findings obtained from this study.

- Conducting the studies with mixed sample groups and using different samples together can contribute to the expansion of the field of STEM education.
- While there are studies on preschool teachers and students in the STEN studies, studies can be carried out on school administrators and academicians involved in preschool education.
- This study examined the effect of STEM studies on the skills of teachers and children in general. From this point of view, the contributions of sample groups to affective field characteristics or psychomotor field characteristics can be examined.
- The study investigated the results of STEM training programs applied in the studies but did not examine the level of their effects after a certain period. At this point, it is recommended to conduct longitudinal studies to see the effects of children receiving stem education in the preschool education process in the long term.

Limitations

This study, which examined in which postgraduate theses on stem education in preschool education in Turkey, was limited to 40 postgraduate theses published between 2018-2022 as a result of using the keywords "preschool STEM education", "preschool STEAM education", "STEM education in early childhood", "preschool children and STEM education", "preschool children and STEAM education".

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ANNEX-1

Information on theses on STEM education in preschool education can be accessed at www.tez.yok.gov.tr.

Thesis Code	Author of the Thesis	Type of	Thesis Title

		Thesis	
T1	Bal, E. (2018)	MT	The examination of the effects of stem (Science, technology, engineering, mathematic) activities on 48-72 months pre-school students' scientific processing and problem solving skills
T2	Başaran, M. (2018)	DT	The applicability of STEM approach in preschool education (Action research)
T3	Çakır, Z. (2018)	MT	Investigation of the effects of pre-school teacher candidates on montessori approach based STEM effectiveness
T4	Öcal, S. (2018)	MT	Examining the effects of early STEM educational program on the scientific process skills of preschool children between 60-66 months
T5	Akçay, B. (2019)	MT	The effects of STEM activities on the problem solving skills of 6 aged preschool children
T6	Aydın, T. (2019)	MT	The effect of STEM applications on preschool students' scientific process skills and cognitive field development
T7	Behram, M. (2019)	MT	Investigation of the effect of STEM applications on 5-6 year old group students
T8	Çilengir Gültekin, S. (2019)	MT	The effects of drama based early STEM program on scientific process and creative thinking in preschool education
T9	Deniz Özgök, A. (2019)	MT	Examination of 60-75 months children's problem solving and cognitive skills in integrated STEM activities
T10	Güldemir, S. (2019)	MT	The effect of STEM activities on creativity in pre-school
T11	Kale, S. (2019)	MT	Investigation of the effect of STEM applications on the scientific process skills of pre-school teachers
T12	Karamete Gözcü, Ş. (2019)	MT	The evaluation of preschool teachers about STEM education and in-class applications
T13	Koç, A. (2019)	DT	The comparison of stem implementations with robotic-assisted and simple materials in preschool and basic science education.
T14	Mercan, Z. (2019)	DT	The effect of early STEAM education program to the childrens visual spatial reasoning skills
T15	Sağbaş, A. (2019)	MT	Implementation of science and mathematics education course redesigned with STEM approach at preschool education department: A case study
T16	Ünal, M. (2019)	MT	Investigate the effect of activity-based STEM education on scientific process skills for 4-6 years old preschool children
T17	Üret, A. (2019)	MT	Effects of STEM education on creativity levels of 5-year- old preschool children
T18	Abanoz, T. (2020)	DT	The examination of the impact of science education activities based on STEM approach on preschool term children's science process skills
T19	Alan, Ü. (2020)	DT	Investigation of the effectiveness of STEM education program for preschoolers
T20	Doğan, M. (2020)	MT	The effects of activities prepared with the STEM approach on the mathematical concept development of children in preschool
T21	Kavak, Ş. (2020)	DT	Impact of STEM education activities on preschool children's basic scientific process skills
T22	Öztürk, Z.D. (2020)	MT	STEM activities pre-school students effecton problem-solving skills
T23	Yalçın, V. (2020)	DT	Investigation of the effect of pre-school STEM activities prepared by the design thinking model on children's creativity and problem-solving skill
T24	Erol, A. (2021)	DT	Reflections of STEM teacher training on early childhood teachers

T25	Kalyoncu, T. (2021)	MT	Investigation of the effect of stem-a activities on the scientific process skills of 60-72 months children
T26	Ramazan, S. (2021)	MT	Opinions of preschool teachers on STEM approach in early childhood (a practical study)
T27	Savaş, Ö. (2021)	MT	Investigation of the effect of STEM education applications developed for children in early childhood on scientific process skills
T28	Şanlı, Z. S. (2021)	DT	The effects of STEM activities on creative thinking and problem solving skills of 60-72 month-children's in early childhood
T29	Tanın, K. (2021)	MT	The effects of STEM activities on pre-school teachers' computational, critical and multidimensional 21st century skills
T30	Ünlü, A.B. (2021)	MT	The effect of STEM education program on ecological footprint awareness in the age of five gruop children who are attending preschool
T31	Üspolat Yazıcı, Z. (2021)	MT	Examining the self-sufficiency perceptions of pre-school teachers who receive stem education and do not receive the teaching of 21ST century skills
T32	Yaşar, Z. (2021)	MT	Preschool teachers' opinions on STEM awareness and STEM activities
T33	Yıldırım, Z. (2021)	MT	The effects of m-stem program on the scientific process skills of children attending montessori preschool
T34	Bursa, E. (2022)	MT	Pre-school of science teaching with inquiry-based STEM activities effects of students on scientific process skills
T35	Çakır, Z. (2022)	DT	The effect of Montessori approach-based STEM education on the learning skills of pre-school teachers
T36	En, S. (2022)	MT	Study concerning practicability of STEM activities in early childhood science lessons according to various variables
T37	Kesicioğlu, S. (2022)	MT	Examination of metaphorical perceptions about STEM education of pre-school teacher candidates and perceptions of self-efficacy
T38	Samur, E. (2022)	MT	The effect of Montessori approach-based STEM activities on academic self-esteem of preschool students
T39	Şahiner, D. (2022)	MT	Science practices implementing the 5E learning model inspired by STEAM education approach in kindergarten education: Action research
T40	Şimşek, V. (2022)	MT	The effect of STEM education practices on creativity and critical thinking skills in preschool period

*MT: master's thesis, DT: doctoral thesis