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Content Analysis of Science Education Research in Special Education Journals

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ABSTRACT This study examines the special education studies on science education in the ERIC database. The main facts to be determined in the content analysis conducted in this study are as follows: subject types of special education studies in the field of science education, change of preferred studies according to years, main objectives, research methods, sample sizes, data collection tools, research method, data analysis method, the types of disabilities of the individuals in the samples, the level of education of the participants, the types of techniques used in the analyses. The articles reviewed in the study were searched in ERIC databases. As a result of the search, 87 articles were examined within the scope of science and special education in nineteen journals. Tables and figures were used to make the findings more understandable. According to study results: It has been concluded that both researchers working in the field of special education and researchers working in the field of science education do not want to conduct science education studies with individuals with special needs; the special education studies mainly were conducted in the field of science and technology; the studies were mainly focused to STEM; it was determined that the most studies were done in the field of science education and the least in the field of physics, chemistry, and astronomy; "Quasi-experimental" and "Multiple design" methods were preferred the most among the quantitative research methods.

Keywords Special Education, Science Education, Meta-synthesis, ERIC Database

1. INTRODUCTION

Individual differences are at the forefront of the factors affecting students' academic success (Pirgon & Babacan, 2013). For this reason, students who differ significantly from their peers in terms of their characteristics and educational needs are expressed as individuals needing special education. Individuals with special needs may differ significantly from their peers, especially physically, mentally, emotionally, socially, and developmentally (Soykan, Gemikonaklı, & Kanbul, 2019). According to the World Health Organization [WHO] (2020), there are more than one billion disabled people worldwide, increasing yearly. Therefore, while making improvements in education policies, the fact that the number of individuals with disabilities is increasing year by year should be taken into consideration.

Individuals with special needs should have a basic literacy level to continue their lives without being dependent on others. This can only be achieved by taking into account the needs of individuals—one of the courses that facilitate the daily life of individuals needing special education in science education. Science literacy provides essential contributions to students in discovering, understanding, and explaining basic natural phenomena and gaining sustainability awareness. When the studies in the field of special education in the literature are examined according to the subject areas, it has been determined that the studies are primarily about specific subject areas. It has been determined that studies on the subject areas curriculum (Gebbels, Evans, & Murphy, 2010; Lee, 2020; Miller, 2012) teaching; (Breit-Smith, Busch, Dinnesen, & Guo, 2017; Cozendey & Costa, 2016; Knight, Creech-Galloway, Karl, & Collins, 2018; Soykan et al., 2019); teaching materials (Carnahan, Williamson, Birri, Swoboda & Snyder, 2016; Marino & Beecher, 2010); teacher education (Kennedy, Rodgers, Romig, Mathews & Peeples, 2018), and students' general problems (Dukes & Lamar-

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Dukes, 2009; Wilson, Kim, & Michaels, 2013) are more common.

In addition to these studies, there are studies in the literature that subject publications for students with special education need content analysis. Some of the content analysis studies carried out are as follows: Content analysis of Australian special education research conducted between 2005 and 2015 (Ralston, Dally, & Dempsey, 2019); Content analysis of studies conducted in the field of special education between 2009-2014 (Sakallı Demirok, Baglama, & Besgul, 2015); Content analysis of master's theses made in the field of special education between 2009-2014 (Sakallı Demirok, Besgul, & Baglama, 2016); Content analysis of doctoral dissertations in special education between 1997-2010 (Walker & Haley-Mize, 2012); Content analysis of experimental studies in the special education journal between 2004-2017 (Fisher et al., 2019); analysis of the papers in the special education congress held between 2007-2017 (Aslan & Özkubat, 2019); Content analysis of the journals published in the special education journal between 2004-2013 (Tiryakioğlu, 2014); Content analysis of theses made in the field of special education between 2008-2013 (Coşkun, Dündar, & Parlak, 2014). In addition to these studies, there are studies conducted in only one subject area in special education: Content analysis on science studies for students with visual impairment 1972-2014 (Sözbilir et al., 2015); Content analysis of theses about gifted students between 2010-2015 (Schreglmann, 2016); Content analysis of studies on teaching science concepts to students with multiple disabilities between 1985 and 2009 (Spooner, Knight, Browder, Jimenez, & DiBiase, 2011); Content analysis of studies on teaching science to students with special learning difficulties between 2008 and 2017 (Karaer & Melekoğlu, 2020).

As mentioned previously, studies in the literature are two types general and special perspectives. Current studies are critical in determining new practices, awareness, and needs in special education. However, in today's world, societies compete for products that can be produced using knowledge. The products presented can include various fields of science. However, importance should be given to all individuals with or without special needs in science education to produce products in the fields of science such as engineering, technology, and astronomy. The situation mentioned here is not that each individual produces in an engineer or a technological field. It is the individual's basic literacy level related to science fields. For this, education and training should be provided by the needs of individuals with special needs. Examining the studies with a method such as content analysis is essential in determining how individuals with special needs are prepared for the future, what kind of scientific studies are done for them and what issues are emphasized in the scientific studies. In particular, the use of special education journals in the ERIC database as the study's dataset, and the fact that science education research in special education was not analyzed with content analysis in this database, adds originality to the study.

In this study, it is thought that examining the trends of the studies in the ERIC database between 2009-2020 in the mentioned directions will give an idea to the conduct of future special education-science education studies and can create new criteria for new studies. Therefore, considering this aim of the study, answers to the following questions were sought:

- What has changed science education research in special education journals over the years?
- What are the main targets of science education research in special education journals?
- Which research methods were used in science education research in special education journals?
- What are the sample sizes in science education studies in special education journals?
- For which disability group was the science education research in special education journals conducted?
- What is the education level of the participants participating in science education research in special education journals?
- What were data collection tools used in science education research in special education journals?
- What kind of data analysis method was used in science education research in special education journals?

2. METHOD

The study has been conducted using the method of document analysis. The meta-synthesis method was used to study the science education studies about special education. Meta-synthesis is a sub-study of content analysis. Meta-synthesis is the interpretation of these themes created by creating themes from studies done on a subject (Çalık & Sözbilir, 2014). The purpose of using the meta-synthesis method in the study is to reveal the orientation of science education studies in special education.

The articles to be reviewed in the study were searched in ERIC databases. Articles covering the years 2010-2020 were based on the keywords "science", "special education", "chemistry," "physics," and "biology". As a result of the search, 87 articles were found within the scope of science and special education in nineteen journals. Studies were examined in detail in terms of year, purpose, method, sample size, sample education level, type of disability, data collection, and analysis. The descriptive analysis method presented the data in tables and figures. All studies were examined in detail in line with the questions determined in the study, and findings were obtained. Tables and figures were used to make the findings more understandable.

3. RESULT AND DISCUSSION

In Table 1, it is seen that the science education studies published in special education journals are mostly

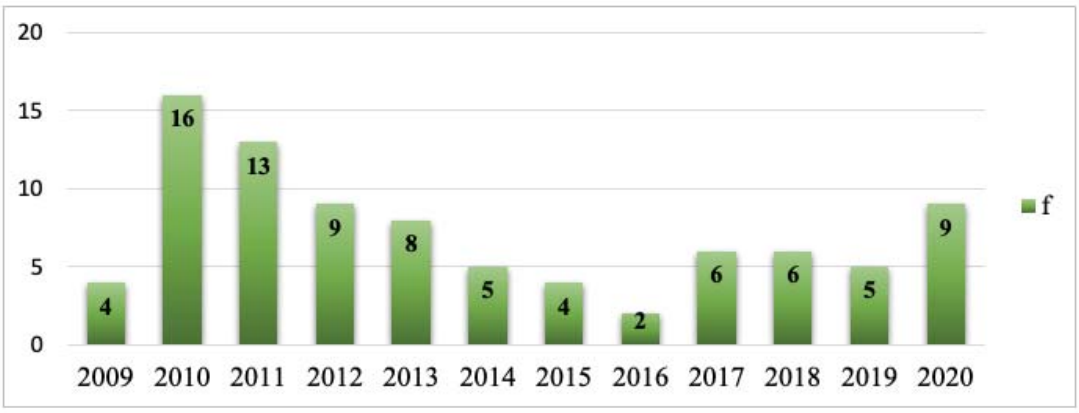

Figure 1 Distribution of articles according to years

published in the Journal of Postsecondary Education and Disability (12) and Teaching Exceptional Children (10); at least in the journals Young Exceptional Children (1), Journal of Research in Special Educational Needs (1), Teacher Education and Special Education (1) and Rural Special Education Quarterly (1) (Figure 1).

In Figure 1, it is seen that 87 science education articles in special education journals were carried out mostly in 2010 (16) and 2011 (13); at least in 2009 (4), 2015 (4), and 2016 (2). In addition, it was determined that while the number of studies regularly decreased between 2010 and 2016, there was no definite decrease or increase between 2017 and 2020.

When the 87 special education journal science education studies in the ERIC database were evaluated according to the number of articles, most were in 2010 and 2011; at least, studies were published in 2009, 2015, and 2016. Although there was not much increase or decrease in the number of studies from 2017 to 2019, there was a significant increase in the number of studies in 2020. According to this finding, it can be said that the number of science education article studies has been in an unbalanced distribution since 2009. In this study, when the content analyses made in the field of special education are examined, it is understood that the number of studies does not maintain stability over the years (Fisher et al., 2019; Sakallı Demirok et al., 2015; Tiryakioğlu, 2014). Aslan and Özkubat (2019) examined the research trends of special education papers. As a result, researchers determined that the number of studies in the field of special education was the highest in 2013, that special education studies remained

Table 1 Distribution of articles according to journals

Journal Name	Frequency (f)
Journal of Postsecondary Education and Disability	12
Teaching Exceptional Children	10
Learning Disabilities Research & Practice	9
Journal of Special Education Technology	8
Focus on Autism and Other Developmental Disabilities	7
Journal of Special Education	6
Remedial and Special Education	6
Learning Disability Quarterly	5
British Journal of Special Education	4
International Journal of Disability, Development, and Education	4
International Journal of Special Education	3
Research and Practice for Persons with Severe Disabilities	3
Journal of the American Academy of Special Education Professionals	2
Journal of Special Education Technology	2
Journal of Learning Disabilities	2
Young Exceptional Children	1
Journal of Research in Special Educational Needs	1
Teacher Education and Special Education	1
Rural Special Education Quarterly	1
Total	87

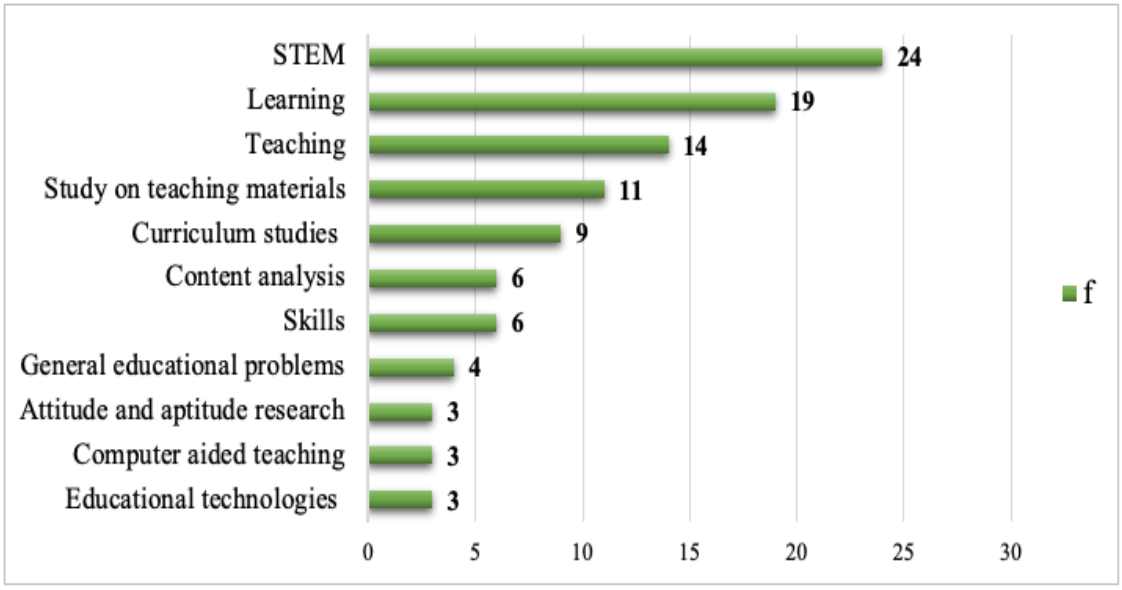

Figure 2 Distribution of articles according to study objectives

stagnant from 201 to 2015, and their number increased again in 2015.

This situation is because a specific fee was given to researchers in 2015 under the academic incentive award, and academics desire to benefit from this free. In addition, this study's highest number of science education studies in special education journals in 2010 and 2011 may be due to the popularity of science subjects studied in these years. Finally, the sharp increase in 2020 compared to previous years can be interpreted as progress in science education studies in special education.

In Figure 2, the target subject areas of science education studies in special education journals are mostly STEM (23), learning (19) and teaching (16); at least general educational problems (4), attitude and aptitude research (3), computer-aided teaching (3) and educational technologies (3) study objectives.

When the science education studies in special education journals were evaluated according to their fields of study, it was determined that most of the studies were conducted in the field of STEM. With people's recognition of 21st-century skills, many multifaceted skills such as the individual's productivity, leadership, self-leadership, and critical skills have come to the fore (Kurudayıoğlu & Soysal, 2019). With the understanding of the importance of 21st-century skills, societies want individuals to adapt to the skills of the new century. In today's world, schools continue to emphasize the fields of Science, Technology, Mathematics, and Engineering (STEM) in the education of societies. (Brown, , Brown, Reardon, & Merrill, 2011) Using a holistic approach such as STEM in the acquisition

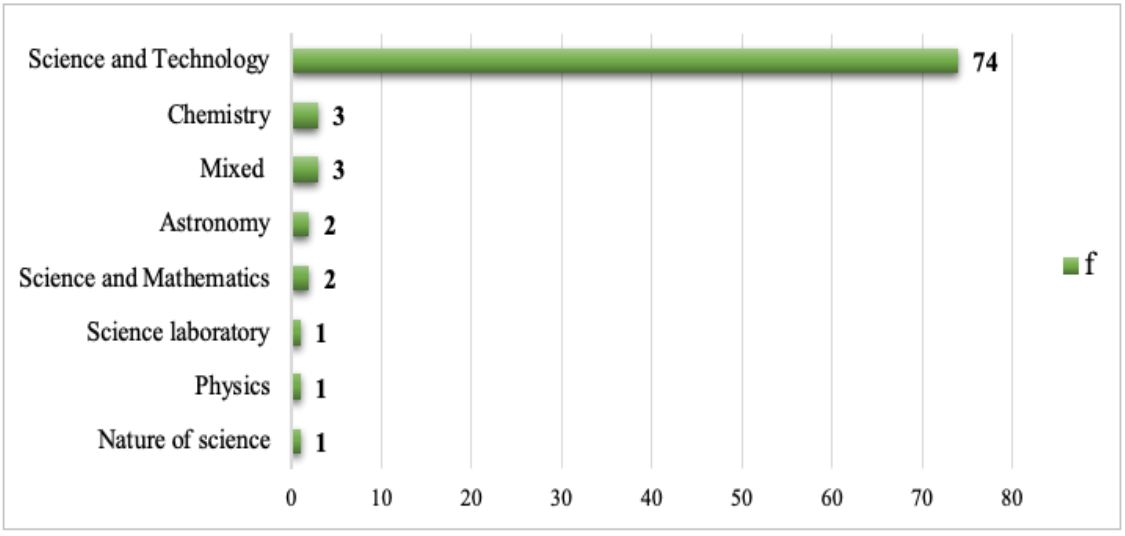

Figure 3 Distribution of articles according to main discipline

Table 2 Distribution of articles according to research method

Research design	Research design type	Frequency	%
Quantitative Research	Quasi-experimental	10	14
	Multiple probe design	10	14
	Longitudinal	6	8
	Other	4	6
	Survey	3	4
	Meta-analysis	2	3
	Multiple baseline design	1	1
	Single-subject design	1	1
	Ex-post facto	1	1
Total		38	52%
Qualitative research	Review	21	27
	Case study	4	6
	Other	2	3
	Cross design	2	3
	Phenomenography	2	3
	Single case design	2	3
	Action research	1	1
	Not reported	1	1
Total		35	48%

21st-century skills may attract the attention of healthy individuals and individuals with special needs. In the literature on this subject, there is also information about the practice of STEM applications in providing skills to individuals with special needs in the 21st century and developing these individuals in psychomotor, affective, and cognitive dimensions (Balçın & Yıldırım, 2021). According to studies, only 65% of special-needs individuals are employed in STEM-based job opportunities (Rivers, 2017). The subject of STEM job opportunities may have attracted researchers' attention and become a popular topic. STEM-based education can effectively increase the interest of individuals with special needs in science and having a job in this field. Based on this information and ideas, having more STEM education studies in special education journals is normal. In addition, this information about the high number of STEM-oriented studies in special education journals is also consistent with other information in the literature (Martin et al., 2011).

In Figure 3, it is seen that the subjects of science and technology (74) are mostly preferred; astronomy (2) and science laboratory (1) subjects are the least preferred, according to their main disciplines.

When the scientific studies in special education journals were evaluated according to their main disciplines, it was determined that the most studies were done in science education and the least in physics, chemistry, and astronomy. Science education is given to individuals early (Ünişen & Kaya, 2015). For this reason, it is quite natural that science education is the most studied subject. However, it is noteworthy that sub-disciplines such as physics, chemistry, and astronomy were studied less in this study. Because science education is divided into sub-disciplines such as physics, chemistry, biology, and astronomy at the high school level, another study found that high school level sample groups mostly suggest that sub-disciplines should have been studied more. It is thought that the sub-disciplines are not studied much at the high school level, or the situation examined in the studies is not clearly expressed, causing the studies to remain superficial.

The frequency distributions of the research methods preferred in 87 science education articles are given in Figure 4. Respectively, quantitative research methods (47%), qualitative research methods (40%), and mixed-method (13%) were used in the articles (Figure 4).

In Table 2, it is seen that quantitative research methods (52%) are preferred more than qualitative research methods (48%) in science education articles in special

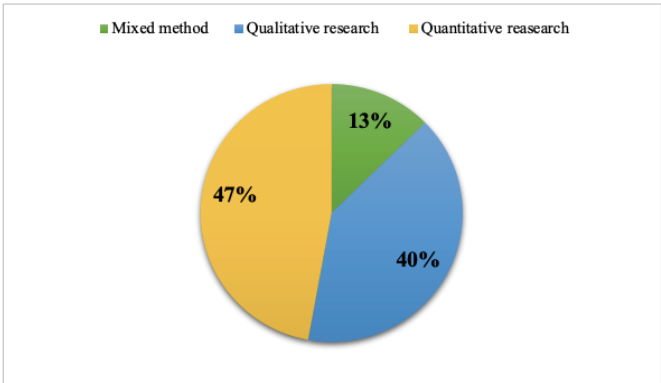

Figure 4 Distribution of articles according to research method

Table 3 Distribution of articles according to data collection tools

Data collection tools	Data collection tool	Frequency	%
Quantitative data collection tools	Questionnaire	14	18
	Likert	7	9
	Tests	6	8
	Open-end	6	8
	Achievement test	5	7
	Multiple choice	5	7
	Multiple resources	4	5
	Task	3	4
	Perception test	1	1
	Attitude test	1	1
	Intelligence test	1	1
Total		53	69%
Qualitative data collection tools	Observation	12	16
	Interview	8	11
	Focus group interviews	2	2
	Portfolio	1	1
Total		23	31%

education journals. According to Table 2, quasi-experimental (10), multiple probe design (10), meta-analysis (2), and single-subject design (1) from the quantitative research methods are the least used. Review (21) from the quantitative research methods is the least preferred; single-case design (2) and action research (1) are preferred. Among the qualitative research methods, review (21) is mostly preferred, while single-case design (2) and action research (1) are the least preferred.

When studies in the field of special education are examined, quantitative research types are generally preferred for individuals with special needs (Çaka, 2020; Çelik, Sarı, & Yıldırım Doğru, 2015; McKissick, Davis, Spooner, Fisher, & Graves, 2018; Sancar, Tozkoparan, & Odabasi, 2017; Soykan et al., 2019). When science education studies in special education journals were evaluated in research methods, it was determined that "Quasi-experimental" and "Multiple design" methods were preferred the most among the quantitative research methods. The main reason for using these methods may be to reach a conclusion by making controlled changes between the samples and to determine the correctness of the hypothesis from this point of view. Therefore, it is a correct practice to use these techniques in studies. Unlike the result of this study (Yıldız, Melekoglu, & Paftalı, 2016) pointed out that there are few experimental studies in the field of special education, and more should be done. However, since individuals with special needs have different characteristics from normal individuals, the researcher may experience problems in collecting data (Cevahir & Özdemir, 2015). When this study finding is evaluated in terms of qualitative research methods, it is noteworthy that a general evaluation is mainly made in the form of a "review". Yılmaz (2019) evaluated the content analyzes on inclusive education and found that qualitative research is more than quantitative research. Finally, the least mixed model is preferred in special education journals. This result may be due to the thought that the multidimensional examination of individuals with special needs may be complex.

In science education studies, quantitative data collection tools (69%) were preferred more than qualitative data collection tools (31%) (Table 3). According to Table 3, as quantitative data collection tools, the mostly questionnaire (14) and the Likert (7) type; at least perception test (1), attitude test (1), and intelligence test (1) type data collection tools are preferred. On the other hand, while observation (12) and interview (8) are mostly preferred among qualitative data collection tools, focus group interviews (2) and portfolio (1) are the least preferred.

When science education studies in special education journals were evaluated in data collection tools, questionnaires, Likert type scale, observation, and interview techniques were preferred most (Boyle, 2010; Carnahan et al., 2016; King-Sears & Johnson, 2020). Questionnaire and Likert-type scales are quantitative data collection tools (Creswell, 2012). Therefore, this finding is consistent with focusing on quantitative research methods in the study. As a result, this finding is consistent with the most preferred data collection tools in similar studies carried out within the scope of special education (Sözbilir et al., 2015; Yılmaz, 2019).

In science education studies, primary 6-8 (22) and secondary 9-12 (12) sample groups were mostly preferred; pre-school (5) and academians (1) sample groups were the least preferred (Figure 5).

When the sample groups were evaluated in terms of grade levels, maximum 6th-8th grades, it was determined

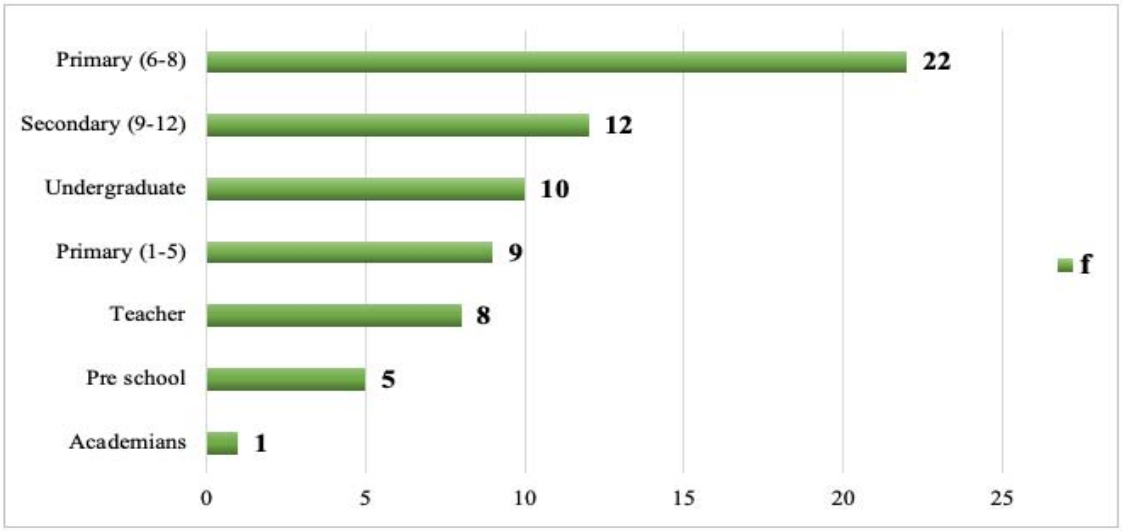

Figure 5 Distribution of articles according to the education level of the sample group

that grade level and high school grade levels were preferred (Cozendey & Costa, 2016; Gebbels et al., 2010; Wilson et al., 2013). This finding is supported by a similar special education study (Sözbilir et al., 2015).

According to Figure 6, It is seen that the sample sizes of science education studies in special education journals are mostly between 11 to 30 (33%) and between 1 to 10 (32%), at least between 101-300 and over 1000.

When science education studies in special education journals were evaluated in terms of sample size, it was determined that the preferred sample size was between 11-30 people and 1-10 students (Mason & Hedin, 2011; VanBuskirk & Simpson, 2013; Wu, Chen, Lo, & Chiang, 2020). This result of the study shows parallelism with the literature (Cevahir & Özdemir, 2015; Sakallı Demirok et al., 2016; Sözbilir et al., 2015). The least preferred sample size in the examined studies is between 101 and 300 people. This situation is because it can be challenging to work with individuals with special needs. Qualitative studies are studies that do not have generalization concerns. However, studies with a quantitative point of view tend to generalize to the universe. For this reason, the preference for large sample groups in studies is significant for the validity and reliability of the study. However, the fact that the sample groups are composed of individuals with special needs may create problems in the conduct of the study.

In Figure 7, It is seen that the science education studies published in special education journals are carried out with mostly special learning disabilities (26), not a disability (13) and autism spectrum disorder (11), at least physically impaired (3) attention–deficit hyperactivity disorders (2) and blind-low vision (1) individuals.

When science education studies in special education journals are evaluated in terms of sample group characteristics, "Special Learning Disability" and "Autism Spectrum Disorder" are the most common; it has been

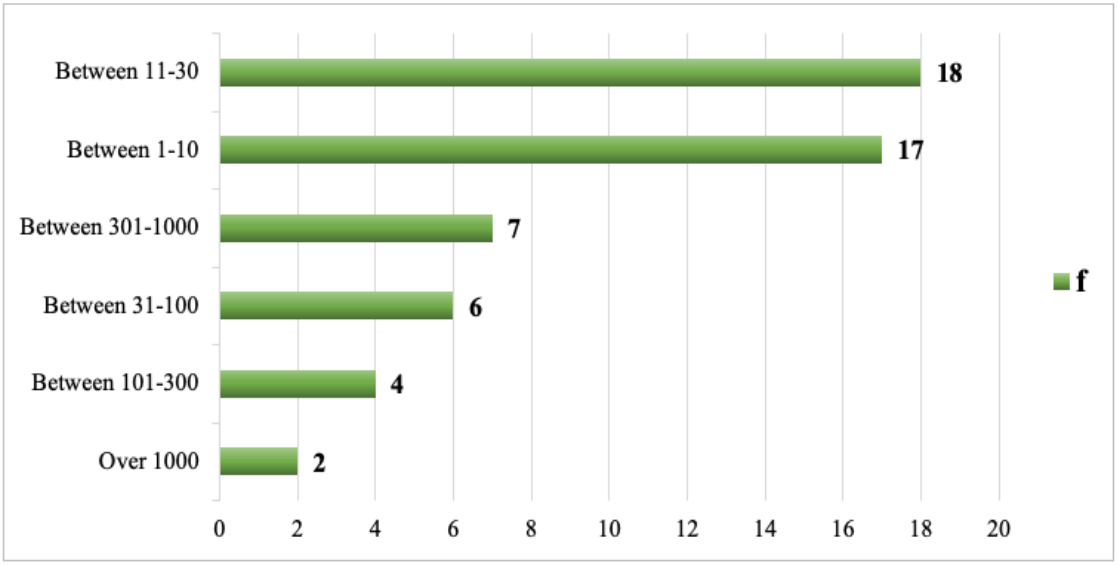

Figure 6 Distribution of articles according to the sample group size

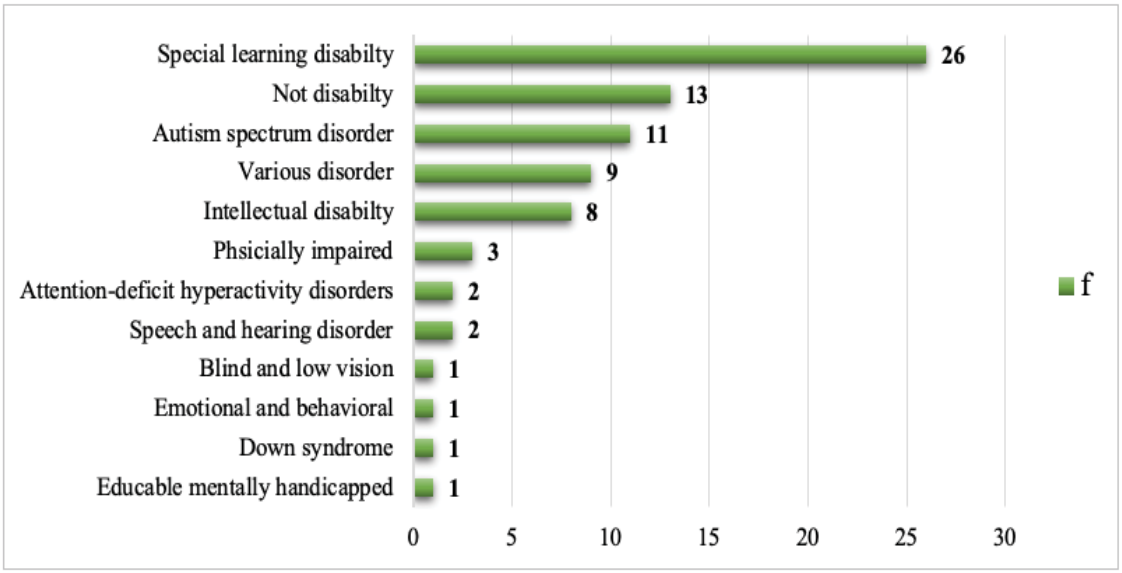

Figure 7 Distribution of participants according to special needs types

determined that it has been studied at least with Emotional and Blind, and Visual impaired individuals. The preference of individuals who do not have needs as the sample group in the studies may be because they are both control and experimental groups. It may be that in the studies examined, working hard with individuals with autism and learning disabilities may be able to receive education under the name of inclusive education in schools. However, individuals with disabilities such as visually impaired and autism receive education with their peers at school according to their needs. From this point of view, it can be said that these individuals are in the sample group that

Table 4 Distribution of articles according to data analysis

Data analysis		Frequency (f)	%
Quantitative Analysis	ANOVA	13	16
	Frequency and percentage tables	14	20
	Logistic regression	6	7
	Descriptive statistics	4	5
	MANOVA	3	4
	Central tendency	3	4
	Meta-analysis	2	2
	t-test	2	2
	Task analysis	2	2
	Regression	2	2
	ANCOVA	2	2
	Correlation	1	1
	Factor analysis	1	1
	Constant comparative analysis	1	1
	Ordinary least squares model	1	1
	Total	57	70%
Qualitative Analysis	Visual analysis	7	9
	Other	6	8
	Content analysis	4	5
	Descriptive analysis	3	4
	Cross case analysis	1	1
	meta-synthesis	1	1
	Constant comparison method	1	1
	Thematic analysis	1	1
Total		24	30%

cannot be easily reached. As a result, there is information that these sample groups are preferred in similar studies (Cevahir & Özdemir, 2015; Sancar et al., 2017).

According to Table 4, it is seen that quantitative data analysis methods (70%) are preferred more than qualitative data analysis (30%) methods in studies. ANOVA (13) and frequency and percentage tables (14) were the most preferred quantitative data analysis methods, while t-test (2) and factor analysis (1) was the least preferred. Among the qualitative research methods, visual analysis (7) was the most preferred, while thematic analysis (1) and meta-synthesis (1) were the least preferred.

When the data analysis methods preferred in science education studies in special education journals were evaluated, quantitative data analysis methods were used the most. The most preferred data analysis methods among quantitative data analyzes are "ANOVA" and "frequency and percentage tables" (Hedrick, Dizen, Collins, Evans, & Grayson, 2010; Therrien, Taylor, Hosp, Kaldenberg, & Gorsh, 2011). In addition, this result coincides with the use of quantitative data analysis techniques, among the data analysis techniques, in studies conducted for similar purposes (Aslan & Özkubat, 2019; Walker & Haley-Mize, 2012). Another analysis technique used in the studies examined is qualitative data analysis techniques. Among the qualitative data analysis, visual analysis, other and content analysis are preferred the most. When this finding was examined in terms of the methods used in the studies examined, it was found to be partially consistent. Because among the qualitative research methods in the studies examined, there are research methods based on document analysis, such as review and content analysis.

CONCLUSION

In this study, which was conducted to determine the inIn the 87 studies, the main facts tried to be determined in the content analysis conducted in this study are as follows: subject types of special education studies in the field of science education, change of preferred studies according to years, main objectives, research methods, sample sizes, data collection tools, research method, data analysis method, the types of disabilities of the individuals in the samples, the level of education of the participants, the types of techniques used in the analyses.

The highest number of studies conducted between 2009 and 2020 belongs to 2010. Science and Technology fields are primarily preferred in special education studies. STEM subject area comes to the fore the most like the target discipline. It can be said that the number of quantitative research methods preferred in studies is the same as the number of qualitative research methods. However, the number of studies conducted with mixed designs is relatively low compared to quantitative and qualitative research designs. In the reviewed articles, the most; Primary (6-8) grade level individuals, Special Learning Disability, and Autism Spectrum Disorder individuals and groups of 1-10 and 11-30 people are preferred. While ANOVA is preferred as quantitative data analysis, visual analysis is preferred as qualitative data analysis.

Based on the results stated, the following suggestions may be recommended:

Since the sample groups consist of individuals with special needs, there may be problems in adopting the researcher or the student with special needs to the practice process. For this reason, more than one researcher can participate in the application process according to the characteristics of the sample groups. Thus, the validity and reliability of the study can be increased by conducting studies with large sample groups.

The number of studies in science and technology is relatively high. The abundance of science and technology-themed studies may lead to repeated studies conducted for the same purpose over time. For this reason, bringing sub-disciplines such as astronomy, science laboratory, biology, physics, and chemistry to the center can lead to the emergence of new and original studies.

STEM subject area is more than other fields. However, it is thought that this area is based on the subject area of science and technology and therefore remains limited. New studies can be combined with sub-disciplines such as astronomy, science laboratory, biology, physics, and chemistry.

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