Analysis of the Studies Examining the Effect of Argumentation-Based Learning Implementation in Science Education

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Abstract—The aim of this study is to analyze the studies investigating the effect of argumentation-based learning methods on students' academic achievement in science education in Turkey and present them in a unity. For this purpose, the document analysis method, which is one of the qualitative research methods, was used. The study included 68 master's theses, 22 doctoral dissertations and 36 articles from the studies conducted on the subject in Turkey between 2007 and 2022. As a result of the analysis, it was determined that the most studies were conducted in 2019, the studies were mostly in the field of science, quasi-experimental designs were mostly used in these studies, achievement tests and attitude scales were mostly used to collect data, and the studies were mostly conducted at the secondary school level.

Keywords: Science Education, Argumentation-Based Learning, Academic Achievement

1. INTRODUCTION

Today, the future of societies depends on their ability to produce and use knowledge (Çınar, Teyfur, & Teyfur, 2006). For this reason, societies are expected to process, produce and use knowledge in their daily lives (Uc & Benzer, 2021). In order to produce and use knowledge, societies need qualified individuals who can research, question, think logically and creatively, and have strong social aspects (Aslan, 2010). Only with such qualified individuals, societies can turn the speed and direction of change in their favour. The qualified individuals needed by societies can only be raised with a qualified education (Hotaman, 2020). Raising qualified individuals can be achieved through a good science education (Ministry of National Education [MEB], 2005). In a good science education process, an individual who produces knowledge, uses knowledge, has developed scientific thinking skills and production skills can only be realized by raising him/her as a good science literate (Özmen & Ayas, 2003; Ünal, Coştu, & Karataş, 2004).

In the most basic sense, science literacy means that individuals actively participate in research-inquiry, critical thinking and problem solving processes, develop decision-making skills for solving problems at the end of the process, and have attitudes, knowledge, skills, values and understanding of science necessary for the continuity and development of lifelong learning and curiosity. It is the vision of the science curriculum that all students grow up as qualified individuals who are science literate regardless of individual differences (Çepni, 2010; Köseoğlu & Tümay, 2013). 21st century skills, depending on the changes in the skills that individuals should have, the desire to raise science literate individuals has led to the need to make changes in science teaching programs.

In our country, inquiry-based learning approach was taken as a basis in the Science Curriculum in 2013 (MEB, 2013). Inquiry-based learning is an approach in which

students try to understand and explain the physical world with solid reasons by constructing arguments and construct knowledge by actively doing, experiencing and thinking (MEB, 2013). In addition, inquiry-based learning includes processes that enable students to ask meaningful questions, review their knowledge by making use of many sources, design various researches, make observations, use data collection tools, analyze and interpret the data obtained, present and defend the information obtained from the researches in various ways with evidence and justifications (National Research Council [NRC], 1996). Through inquiry-based learning, students are included in the learning process and have the opportunity to understand how scientists produce and develop knowledge (NRC, 1996). In addition, argumentation-based learning method, which is based on inquiry, is stated as one of the methods recommended to be used in the 2013 Science Curriculum (MEB, 2013).

With the rapid advancement of science and technology, the existing curricula are inadequate, so in order to add innovations in science and technology to the curriculum, the Science Curriculum was revised in 2018 based on the previous curriculum and according to today's needs (Aydın & Uluay, 2018). With the latest regulations in the field of science education, student-centered methods such as argumentation, project, problem, collaborative learning, etc. were added to the curriculum. Thanks to the newly added methods, it is aimed for students to learn permanent and meaningful information, to reflect the information they have learnt to daily life, and to raise students as innovative, creative, entrepreneurial, and research-minded individuals (MEB, 2018). For this reason, in the lesson plans prepared considering the 2018 Science Curriculum, the research-inquiry process was prepared not as "discovery and experiment" in which students are less active, but as "explanation and argument" process in which students are fully active in the process under the supervision and guidance of the teacher (MEB, 2018). For this purpose, methods should be used in which students can be fully active, in which activities take place in the process, and in which they learn by researching, questioning and developing their thinking skills instead of learning by memorizing information (Yeşildağ & Günel, 2013). For this purpose, one of the methods adopted in the program is the "argumentation-based learning" method.

In argumentation-based learning method, students ask questions, make claims and support these claims with evidence while accessing information. As students share their claims with the group or class while creating and supporting their claims, they reach knowledge through active learning (Osborne, Erduran, & Simon, 2004). In Turkey, argumentation-based learning method was first called learning by doing and experiencing (Günel, Kabataş-Memiş, & Büyükkasap, 2010). With the argumentation-based learning method, students construct knowledge by asking questions, making claims and supporting their claims with evidence in a research-inquiry based learning environment. Argumentation-based learning method is a student-centered approach and students are involved in learning. The basis of argumentation-based teaching is critical thinking, research-inquiry, reaching a conclusion and supporting the conclusion with evidence (Kariper et al., 2014). One of the most important steps of the argumentation-based learning process is the discussion step. Discussion activities are as important for the reliability and validity of scientific knowledge as discussion activities are for the construction of knowledge in science courses (Kuhn, 2009).

In the literature, Günel and Hasançebi Yeşildağ (2013); Bayram and Ulu (2015); Demirel, (2016); Aydoğdu, (2017); Aktaş and Doğan (2018); Yalçınkaya (2018); Aydın and Uluay (2018); Demir, (2018); Cömert (2019); Demir and Gönen (2019); Ulu (2019); Er and Kirindi (2020); Eroğlu and Yıldırım (2020); Tüysüz and Demirel (2020); Bayram,

Akkaş Çakan and Kabataş Memiş (2020); Benzer and Özdem Köse (2021); Benzer and Uç (2021); Bolat, Soylu and Uluçınar Sağır (2021); Bozkurt and Doğru (2021) and Karacalı and Özkan (2021) stated that argumentation-based learning increases students' academic achievement.

The continuous increase in the number of studies using argumentation-based learning method makes it difficult to follow the literature (Hafızoğlu & Bahar, 2020). For this reason, document review studies conducted in the field determine the general trend and present the studies as a whole. In this study, document analysis was conducted for the studies examining the effect of argumentation-based learning approach on students' academic achievement in the field of science in Turkey. The fact that the research was carried out in a more specific field led to the emergence of a detailed study. In addition, it is thought that analyzing and presenting the examined studies as a whole will guide researchers who want to work in this field. The aim of this study is to analyze the studies investigating the effect of argumentation-based learning method on students' academic achievement in science education in Turkey and present them as a whole. For this purpose, the studies published on the subject were analyzed and answers to the following questions were sought:

- What is the distribution of the studies by years?
- What is the distribution of the studies according to their main disciplines?
- Which research methods were used in the studies?
- Which data collection tools were used in the studies?
- Which sample groups were preferred in the studies?
- Which sample size was used in the studies?
- Which data analysis methods were used in the studies?

2. METHODS

2.1 Research Model

In this study, document analysis method, which is one of the qualitative research methods, was used. Document review means the examination of documents related to the subject in accordance with scientific principles (Caymaz, 2022). In document review, the content of materials in printed or electronic media is meticulously systematically analyzed (Kıral, 2020). Bowen (2009) defines document review as a systematic process used to examine or evaluate materials in printed or electronic media. In addition, Bowen (2009) explains the finding of data in the document review process, the selection of the data found, the interpretation and synthesis of the selected data as the analytical process of document review.

2.2 Limitations of the Study

Studies examining the effect of argumentation-based learning method in science education on academic achievement were included in the research. While examining the literature, studies that did not include any of the concepts of science education, argumentation-based learning method and academic achievement were not included in the research. The independent variable of the research, that is, the studies in which another learning method other than argumentation-based learning method was used, the studies in which the effects of the two learning methods were used separately and their effects on academic achievement were compared, and the studies in which the effect of argumentation-based learning method on academic achievement was investigated by integrating it into another learning method were included in the research.

Studies examining the effect of integrating another learning method into argumentation-based learning method on academic achievement were not included in the study. Studies that included other variables (science process skills, attitude, motivation, etc.) other than academic achievement, which is the dependent variable of the study, were included in the study, but the data on variables other than academic achievement were not included in the study.

2.3 Data Collection

In order to identify the studies investigating the effect of argumentation-based learning method on students' academic achievement in science education, YÖK National Thesis Centre and Uşak University Prof. Dr. Fuat Sezgin Library databases were used for master's and doctoral theses and Google Scholar, Dergipark and Uşak University Prof. Dr. Fuat Sezgin Library databases were used for articles. Certain keywords (argumentation, academic achievement, argumentation-based learning, argumentation-based learning) were used to scan the theses. As a result of the thesis search, 68 master's and 22 doctoral theses were included in the study. Specific keywords (argumentation, academic achievement, argumentation-based learning, argumentation-based learning) were used to scan the articles. As a result of article screening, 36 articles were included in the study. During the data collection process, it was determined that the first study serving the purpose of the study was conducted in 2007 and the last study was conducted in 2022.

2.4 Analyzing the Data

Firstly, a form was created by the researchers to analyze the articles and theses. In this examination form, the articles and theses were analyzed under the following headings: "year of publication, main discipline to which they belong, research methods, data collection tools, samples, sample sizes and data analysis". Each of the articles and theses were examined comprehensively within the framework of these headings, and descriptive analysis method was used to analyze the articles and theses. In descriptive analysis, the data obtained during the research process are collected systematically, and the collected data are described and explained (Yıldırım & Şimşek, 2013). In descriptive analysis, the aim is to summarize and interpret the data obtained as a result of the research depending on the limitations determined by the researcher. The findings of the analysis are firstly systematically organized, interpreted and some results are obtained. The researcher can interpret these results and make forward-looking predictions (Yıldırım & Şimşek, 2016). In this study, a total of 126 studies, including 36 articles, 68 master's theses and 22 doctoral theses, were analyzed. The data obtained were analyzed by descriptive analysis method and presented in tables.

3. RESULTS

The distribution of articles and theses according to the years of publication is presented in Table 1.

When Table 1 is analyzed, it is seen that the oldest study on the subject is a master's thesis published in 2007. In 2008 and 2009, no study was found on the subject. In 2010 and 2011, two master's theses and one doctoral thesis were published on the subject, but no article was published. In 2012, one article and three master's theses were

published, but no doctoral thesis was published. In 2013, two articles, one master's thesis and two doctoral theses were published.

Table 1. Distribution of Articles and Theses by Publication Year

Year	Article	MA Thesis	DR Thesis	Year	Article	MA Thesis	DR Thesis
2007	-	1	-	2015	3	1	1
2008	-	-	-	2016	3	2	1
2009	-	-	-	2017	2	6	3
2010	-	2	1	2018	2	5	1
2011	-	2	1	2019	2	24	7
2012	1	3	-	2020	7	11	2
2013	2	1	2	2021	10	3	1
2014	2	6	1	2022	2	1	1

In 2014, two articles, six master's theses and one doctoral thesis were published. In 2015, three articles, one master's thesis and one doctoral thesis were published. In 2016, three articles, two master's theses and one doctoral thesis were published. In 2017, two articles, six master's theses and three doctoral theses were published. In 2018, two articles, five master's theses and one doctoral thesis were published. In 2019, two articles, 24 master's theses and seven doctoral dissertations were published. In addition, it is seen that the highest number of studies was 33 in 2019. In 2020, seven articles, 11 master's theses and two doctoral theses were published. In 2021, 10 articles, three master's theses and one doctoral thesis were published. Finally, two articles, one master's thesis and one doctoral thesis were published in 2022. When we look at the years in which the most publications were carried out in terms of publication types; it is seen that articles were published in 2021, master's theses were published in 2019, and doctoral theses were published in 2019.

The distribution of articles and theses according to their main disciplines is given in Table 2.

Table 2. Distribution of Articles and Theses According to Their Main Disciplines

Main Discipline to which It Belongs	Article	MA Thesis	DR Thesis	Total
Science	26	53	13	92
Biology	3	6	1	10
Physics	1	3	-	4
Chemistry	2	3	6	11
Environmental Education	4	3	2	9

When Table 2 is examined, it is seen that 26 articles, 53 master's theses and 13 doctoral theses were published in the field of Science. In addition, it is seen that the most research was conducted in the field of Science with 92 studies in total. It is seen

that three articles, six master's theses and one doctoral thesis were published in the field of biology. It is seen that one article and three master's theses were published in the field of Physics, but no doctoral thesis was published. In addition, it is seen that the least number of publications was made in the field of Physics with a total of four studies. It is seen that two articles, three master's theses and six doctoral theses were published in the field of Chemistry. In Environmental Education, four articles, three master's theses and two doctoral theses were published.

Research methods used in articles and theses are given in Table 3.

Table 3. Research Methods Used in Articles and Theses

Research Methods	Article	MA Thesis	DR Thesis
Quasi-Experimental Design	25	50	9
Weak Experimental Design	5	2	1
Combining (Variation) Pattern	1	4	2
Explanatory Sequential Pattern	3	6	3
Embedded (Nested) Pattern	-	4	6
Intervention Experimental Design	-	1	-
Action Research	-	-	1
Case Study	1	-	-
Meta-analysis	1	-	-
Multiple Methods	-	1	-

When Table 3 is analyzed, it is seen that the most commonly used research method in articles and theses is the quasi-experimental design with 84 studies in total. It is seen that 25 of the studies conducted with quasi-experimental design are articles, 50 of them are master's theses and nine of them are doctoral theses. It is seen that five of the studies conducted using weak experimental design are articles, two are master's theses and one is a doctoral thesis. It is seen that one article, four master's theses and two doctoral theses were conducted using the combining (triangulation) design. When the table is examined, it is seen that three articles, six master's theses and three doctoral theses were conducted with explanatory sequential design. It is seen that four of the studies conducted using embedded design are master's theses and six of them are doctoral theses. It is seen that no article has been published on the subject using the embedded design. It is seen that one master's thesis was conducted using intervention experimental design, one doctoral thesis using action research, one article using case study, one article using meta-analysis method and one master's thesis using multi-method method.

The distribution of data collection tools used in articles and theses is given in Table 4. When Table 4 is analyzed, it is seen that different data collection tools were used in the studies. When the scales section in Table 4 is analyzed, it is seen that there are 10 different scales. There are eight articles, 24 master's theses and seven doctoral theses in which data were collected using attitude scales. There are one article, three master's theses and three doctoral dissertations in which data were collected using critical thinking scales. There are three articles, one master's thesis and one doctoral dissertation in which data were collected using inquiry skills scales.

Table 4. Distribution of Data Collection Tools Used in Articles and Theses

	Data Collection Tools	Article	MA Thesis	DR Thesis
Scales	Attitude Scales	8	24	7
	Critical Thinking Scales	1	3	3
	Questioning Skill Scales	3	1	1
	Motivation Scales	-	3	1
	Self-Efficacy Scales	-	3	2
	Willingness to Discuss Scales	1	-	2
	Evaluation Scales	2	4	1
	Scales of Interest	-	1	1
	Learning Scales	-	-	2
	Other Scales	4	11	6
Tests	Achievement Tests	27	59	18
	Concept Tests	6	6	5
	Other Tests	6	25	17
Others	Reports	3	4	5
	Surveys	4	12	5
	Inventories	2	4	-
	Interview	8	23	21
	Scoring Keys	-	-	2
	Events	-	4	3
	Working Papers	2	3	2
	Scenarios	1	-	1
	Records	1	3	1
	Diaries	-	1	4
	Observations	-	2	2
	Discussions	-	1	2
	Rubric Scoring Key	1	1	2
	Question Forms	-	2	3
	Document Review	1	1	-

It is seen that there are three master's theses and one doctoral thesis in which data were collected using motivation scales, but there is no article. It is seen that there are three master's theses and two doctoral theses in which data were collected using self-efficacy scales, but there is no article. It is seen that there are one article and two doctoral theses in which data were collected using the willingness to discuss scales, but there is no master's thesis. It is seen that there are two articles, four master theses and one doctoral thesis in which data were collected using evaluation scales. It is seen that there is one master thesis and one doctoral thesis in which data were collected using interest scales, but there is no article. It is seen that there are two doctoral theses in which data were collected using learning scales, but there is no article or master thesis. It is seen that there are four articles, 11 master's theses and six doctoral theses in which data were collected using other scales. Looking at the tests section in Table 4, it is seen that there are three different tests. It is seen that there are 27 articles, 59 master's theses and 18 doctoral theses in which data were collected using achievement tests. In addition, the most used data collection tool is achievement tests with 104 studies in total. There are six articles, six master's theses and five doctoral dissertations in which data were

collected using concept tests. There are six articles, 25 master's theses and 17 doctoral dissertations in which data were collected using other test types. There are three articles, four master's theses and five doctoral dissertations in which data were collected using reports. In four articles, 12 master's theses and five doctoral dissertations, it is seen that the data were collected with questionnaires. It is seen that there are two articles and four master's theses in which data were collected using inventories, but there is no doctoral thesis. It is seen that there are eight articles, 23 master's theses and 21 doctoral theses in which data were collected through interviews. It is seen that there are two doctoral theses in which data were collected using scoring keys, but there are no articles or master's theses. It is seen that there are four master's theses and three doctoral theses in which data were collected with activities, but there is no article. It is seen that there are two articles, three master's theses and two doctoral theses in which data were collected using worksheets. It is seen that there is one article and one doctoral thesis in which data were collected with the help of scenarios, but there is no master's thesis. It is seen that there is one article, three master's theses and one doctoral thesis in which data were collected with the help of records. It is seen that there are one master's thesis and four doctoral theses in which data were collected with the help of diaries, but there is no article. It is seen that there are two master's theses and two doctoral theses in which data were collected through observations, but there is no article. It is seen that there are one master's and two doctoral theses in which data were collected with the help of discussions, but there is no article. It is seen that there is one master's thesis, doctoral thesis and article in which data were collected with Rubric Scoring Key. It is seen that there are two master's theses and three doctoral theses in which data were collected with questions, but there is no article. It is seen that there is one article and one master's thesis but no doctoral thesis in which data were collected with the help of document analysis.

The results of the analyses based on the education level of the sample group used in the studies are presented in Table 5.

Table 5. Sample Groups in Articles and Theses

Sample	Article	MA Thesis	DR Thesis
Primary School (1, 2, 3, 4)	2	4	1
Secondary School (5, 6, 7, 8)	24	46	13
High School (9, 10, 11, 12)	2	8	3
Undergraduate level	7	10	5
Other	1	-	-

When Table 5 is examined, it is seen that there are two articles, four master's theses and one doctoral thesis conducted with the primary school level sample group; 24 articles, 46 master's theses and 13 doctoral theses conducted with the secondary school level sample group. In addition, it is seen that the most frequently used sample group in the studies was carried out at the secondary school level with 83 studies. It is seen that there are two articles, eight master's theses and three doctoral dissertations conducted with high school level sample group. It is seen that there are seven articles, 10 master's theses and five doctoral dissertations conducted with undergraduate level

sample group. It is seen that there is one article conducted with the other sample level, but there is no master's or doctoral thesis.

The distribution of the number of people in the sample used in the studies is given in Table 6.

Table 6. Sample Size in Articles and Theses

Sample Size	Article	MA Thesis	DR Thesis
11 to 20	2	2	-
21 to 30	1	6	-
31 to 40	5	13	3
41 to 50	8	10	3
51 to 60	9	9	2
61 to 70	7	13	4
71 to 80	3	8	1
81 to 90	1	4	1
91 to 100	-	-	3
101 to 120	-	2	2
121 to 140	-	-	2
141 to 160	-	-	-
161 to 180	-	1	-
181 to 200	-	-	-
201 and above	-	-	1

When Table 6 is examined, it is seen that there are two articles and two master's theses with a sample size between 11 and 20, but no doctoral thesis. There is one article and six master's theses with a sample size between 21 and 30, but no doctoral thesis. Between 31 and 40, there are five articles, 13 master theses and three doctoral dissertations; between 41 and 50, there are eight articles, 10 master theses and three doctoral dissertations; between 51 and 60, there are nine articles, nine master theses and two doctoral dissertations; 61 to 70 sample size: seven articles, 13 master's theses and four doctoral theses; 71 to 80 sample size: three articles, eight master's theses and one doctoral thesis; 81 to 90 sample size: one article, four master's theses and one doctoral thesis. With a sample size between 91 and 100, there are three doctoral theses, but no articles or master's theses. With the sample size between 101 and 120, it is seen that there are two master's theses and two doctoral theses, but there is no article. Between 121 and 140, there are two doctoral theses, but no articles or master's theses. It is seen that there is no study conducted with the sample size between 141 and 160. Between 161 and 180, it is seen that there is one master's thesis conducted with the sample size between 161 and 180, but there is no article or doctoral thesis. It is seen that there is no study conducted with a sample size between 181 and 200. With a sample size of 201 and above, it is seen that there is a doctoral thesis, but there is no article or master's thesis.

Data analysis methods used in articles and theses are given in Table 7. When Table 7 is examined, it is seen that there are six articles, 11 master's theses and eight doctoral dissertations in which data analysis is done with Frequency / Percentage tables. It is seen that there are 15 articles, 34 master's theses and 18 doctoral dissertations in which the data were analyzed with the Descriptive Analysis method. There are eight articles, 17

master's theses and seven doctoral dissertations in which data were analyzed by ANCOVA/MANCOVA method.

Table 7. Data Analysis Methods Used in Articles and Theses

Data Analysis	Article	MA Thesis	DR Thesis
Frequency/Percentage Tables	6	11	8
Descriptive Analysis	1	34	18
ANCOVA/MANCOVA	8	17	7
Dependent Groups T-Test	19	41	7
Independent Groups T-Test	20	50	12
Mann-Whitney U Test	8	17	8
Wilcoxon Test	4	12	6
Kolmogorov-Smirnov Test	7	12	3
Shapiro-Wilks Test	7	13	6
ANOVA/MANOVA	5	9	11
Correlation	2	5	5
Content Analysis	1	9	8
Factor Analysis	-	-	4
Hedges' Effect Size	-	-	1
Kruskal Wallis	-	1	2
Chi-Square Analysis	-	1	1
Item Analysis	-	2	-

It is seen that there are 19 articles, 41 master's theses and seven doctoral dissertations in which the data were analyzed with the Dependent Groups T-Test; 20 articles, 50 master's theses and 12 doctoral dissertations in which the data were analyzed with the Independent Groups T-Test method. In addition, it is seen that the most commonly used data analysis method in the studies is independent groups t-test with a total of 82 studies. It is seen that there are eight articles, 17 master's theses and eight doctoral dissertations in which data analysis is performed with Mann-Whitney U Test; four articles, 12 master's theses and six doctoral dissertations in which data analysis is performed with Wilcoxon Test method; seven articles, 12 master's theses and three doctoral dissertations in which data analysis is performed with Kolmogorov-Smirnov Test; seven articles, 13 master's theses and six doctoral dissertations in which data analysis is performed with Shapiro-Wilks Test method. There are five articles, nine master's theses and 11 doctoral dissertations in which data were analyzed by ANOVA/MANOVA method. There are two articles, five master's theses and five doctoral dissertations in which data were analyzed by correlation method. One article, nine master's theses and eight doctoral dissertations were analyzed by Content Analysis method. It is seen that there are four doctoral theses in which the data were analyzed with the Factor Analysis method, but there are no articles or master's theses. It is seen that there is one doctoral thesis in which data analysis is performed with Hedges' Effect Size method. It is seen that there are one master thesis and two doctoral theses in which the data were analyzed using the Kruskal Wallis method; one master thesis and one doctoral thesis in which the data were analyzed using the Chi-square Analysis method; and two master theses in which the data were analyzed using the Item Analysis method.

4. DISCUSSION AND CONCLUSION

In this study, 36 articles, 68 master's theses and 22 doctoral dissertations were analyzed among the studies examining the effect of argumentation-based learning approach on students' academic achievement in the field of science in Turkey. When the identified studies were examined, it was seen that the most studies examining the effect of argumentation-based learning approach on students' academic achievement in the field of science were published as master's thesis and the least studies were published as doctoral thesis. Yıldırım (2020), in his document review study on the studies in which argumentation-based learning method was used in science education between 2010 and 2020, determined that 38.6% were master's, 32.5% were doctoral and 28.8% were article type studies. Similarly, Hafızoğlu and Bahar (2020) stated that the most studies on argumentation in science education were conducted at the master's level. Inam and Güven (2019) examined the experimental studies in which argumentation method was used and stated that the experimental studies in which argumentation method was used were mostly conducted at the master's level. Cirit Gül, Apaydın, and Çobanoğlu (2021) examined the postgraduate theses on argumentation in Turkey by thematic content analysis method and stated that the highest number of studies with a rate of 72.42% was at the master's level, while the rate of doctoral thesis was 31.68%. Kabataş Memiş (2017) analysed the theses on argumentation in Turkey and stated that 65% of the theses were conducted at master's level and 35% at doctoral level. Karakuş and Yalçın (2016) examined the studies investigating the effect of argumentation-based learning on academic achievement and scientific process skills in science education between 2007 and 2015, and stated that the most studies were at master's level and the least studies were at article level.

When the distribution of the studies according to years was examined, it was seen that the least study was conducted in 2007 and the most studies were conducted in 2019. After 2019, the reason for the decrease in studies can be shown as the inability to conduct experimental studies due to the pandemic in 2020. When we look at the years in which the most studies were conducted in terms of publication types; it is seen that articles were conducted in 2021, master's theses in 2019, and doctoral theses in 2019. Yıldırım (2020) stated that the studies on argumentation-based learning method in science education between 2010-2020 were conducted mostly in 2019 and the least in 2020. In addition, when Yıldırım (2020) looked at the years in which the studies were carried out the most in terms of publication types, he stated that articles were conducted in 2018 (9.20%), master's theses in 2019 (9.20%), and doctoral theses in 2016 (6.13%). Hafızoğlu and Bahar (2020), looking at the distribution of postgraduate theses on argumentation in science education at primary and secondary school level between 2009 and 2019 according to years, stated that the most studies were conducted in 2019 and the least studies were conducted in 2010. İnam and Güven (2019) examined the experimental studies in which argumentation method was used by meta-synthesis method and stated that the most studies were conducted in 2014. Cirit Gül, Apaydın, and Çobanoğlu (2021) examined the postgraduate theses on argumentation in Turkey by thematic content analysis method, and when they looked at the distribution of studies according to years, they stated that the most studies were published in 2019.

Considering the main disciplines to which the analyzed studies belonged, it was seen that the most studies were conducted in the field of science and the least studies were conducted in the field of physics. İnam and Güven (2019) analyzed the experimental studies using argumentation method by meta-synthesis method and stated that the most studies were conducted in science subjects. Cirit Gül, Apaydın, and

Çobanoğlu (2021) examined the postgraduate theses on argumentation in Turkey by thematic content analysis method and stated that the most studies were conducted in the field of science. Kabataş Memiş (2017) analyzed the theses on argumentation in Turkey between 2005 and 2015 by meta-synthesis method and stated that the most studies were conducted in the field of science. Karakuş and Yalçın (2016) analyzed the studies investigating the effect of argumentation-based learning on academic achievement and scientific process skills in science education between 2007 and 2015 by meta-analysis method, and stated that the most studies were conducted in chemistry subjects and the least studies were conducted in biology subjects.

When the research methods used in the studies were analyzed, it was seen that the most commonly used research method was quasi-experimental design. Yıldırım (2020) stated in his study on the studies using argumentation-based learning method in science education that quantitative research method was used the most, followed by mixed and qualitative research methods respectively. Hafızoğlu and Bahar (2020) stated that 44.1% of the studies used mixed research method, 35.3% used quantitative research method, and 20.6% used qualitative research method. İnam and Güven (2019) examined the experimental studies in which the argumentation method was used and stated that 78.78% of the studies used quasi-experimental design and 6.06% of the studies used full experimental design model. Kabataş Memiş (2017) stated that quantitative research method was mostly used in theses on argumentation in Turkey, followed by qualitative and mixed research methods respectively.

It was observed that achievement tests were mostly used as data collection tools in the studies. Inam and Güven (2019) stated that the most commonly used data collection tools in experimental studies using the argumentation method were achievement test, interview, attitude scale and rubric, respectively. Cirit Gül, Apaydın, and Çobanoğlu (2021) stated that the most frequently used data collection tools in postgraduate theses on argumentation in Turkey are knowledge, achievement or concept tests. It is thought that achievement tests and attitude scales are used more frequently because quantitative research methods are used more frequently (Temel et al., 2014; Taş et al., 2019).

Considering the sample groups selected for data collection in the studies, it was observed that most of the studies were conducted with secondary school students. These findings coincide with other studies in the literature (İnam & Güven, 2019; Yıldırım, 2020; Cirit Gül, Apaydın, & Çobanoğlu, 2021). Kabataş Memiş (2017) examined the theses on argumentation in Turkey and stated that the most preferred sample group was secondary school. Cirit Gül, Apaydın, and Çobanoğlu (2021) examined the postgraduate theses on argumentation in Turkey by thematic content analysis method and stated that the sample groups in which the studies were conducted were 43.20% secondary school students, 32.10% undergraduate students, 11.11% secondary school students, 6.58% primary school students, 2.88% teachers, 2.05% both students and teachers, and 0.41% preschool students. Hafızoğlu and Bahar (2020) stated that the most preferred sample groups were 7th grade students and pre-service science teachers.

When the preferred sample sizes in the studies are examined, it is seen that most of the studies were conducted with a sample size between 61 and 70. Cirit Gül, Apaydın, and Çobanoğlu (2021) stated that 63.37% of the postgraduate theses on argumentation in Turkey were conducted with a sample size between 31 and 100, while 20.16% were conducted with a sample size between 11 and 30. Kabataş Memiş (2017) stated that the most preferred sample size in the studies consisted of people between 30 and 100.

It was seen that the independent groups t-test data analysis method was mostly used to analyze the data collected in the studies. Hafızoğlu and Bahar (2020) stated that content analysis was mostly used among qualitative data analysis methods and t-test was mostly used among quantitative data analysis methods. İnam and Güven (2019) stated that quantitative data analysis method was predominantly used in the studies and t-test was used the most among quantitative data analysis methods, while descriptive analysis method was used the most among qualitative data analysis methods. Cirit Gül, Apaydın, and Çobanoğlu (2021) stated that parametric tests were mostly used in postgraduate theses on argumentation in Turkey. Kabataş Memiş (2017) stated that parametric tests are used more and the most commonly used parametric test is t-test.

Depending on the results obtained from this study, the following suggestions can be made; this study only included studies examining the effect of argumentation-based learning approach on students' academic achievement in the field of science in Turkey. In this regard, the study can be expanded to include other dependent variables. Similarly, only the studies published in Turkey by scientists in Turkey were analyzed in the study. The study can be expanded by including studies published abroad. By analyzing the studies conducted by scientists abroad on this subject, Turkey and abroad can be compared. Thus, Turkey's place in the world literature can be determined. It was determined that traditional measurement tools were mostly used as data collection tools in the studies. In future studies, the use of more complementary measurement and evaluation data collection tools in order to conduct process-oriented measurement and evaluation may produce more efficient results.

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