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Trends in PhD Theses in Turkish Chemistry Education (1999-2019)*

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ABSTRACT

Purpose: This study analyzes the content of doctoral theses completed in chemistry education within the last two decades (1999-2019) after the restructuring of education faculties in Turkey. This study examines the doctoral dissertations completed in chemistry education in 1999-2019 concerning their year of publication, university, objective, research design, sample properties, data collection tools and data analysis methods.

Research Methods: This study was conducted using the qualitative research method of document review. The documents analyzed as part of this study were PhD theses completed in chemistry education in Turkey in 1999-2019. The theses were subjected to descriptive content analysis.

Findings: The findings obtained in this study showed that the number of theses began to increase in 2001 and reached its peak in 2012, before beginning to taper off in the following years. The Middle East Technical University published the highest number of theses. It was observed that most theses concerned the development and implementation of a teaching method. Quasi-experimental designs featured prominently as a research method, with most samples comprising high-school-level study groups. Although examples of quantitative research were more on the whole, in recent years, there was a higher number of studies based on mixed and qualitative research. Interviews and concept testing/achievement tests were frequently observed as data collection tools, while inferential and descriptive statistics were predominantly brought to bear as data analysis methods.

Implications for Research and Practice: This findings obtained in this study suggest that more emphasis should be placed on graduate courses that teach research methods, incorporating more practice sessions because the research methods used in the theses were not specified appropriately by the researchers. There is also a need, in keeping with international trends, to focus more on mixed method research, and to increase the number of qualitative studies, which do a better job of exploring educational environments naturally.

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Introduction

Chemistry emerged in the 18th century as a field of science that explores matter, its internal structure and its interactions. Chemistry is an academic branch that makes discoveries and contributes to theoretical and applied sciences. Chemistry education, on the other hand, concerns itself with questions, such as what to teach and how to teach it, what the knowledge content should be and how successful teaching practices have become. The establishment of chemistry education as a scientific field is relatively new compared to the academic science of chemistry itself. The science of chemistry education, which is interested in how to teach chemistry effectively, is a hybrid field of research that requires the researcher to both be well-versed in the essentials of educational sciences and have expert knowledge of the subject matter in chemistry (Gilbert, 2006; Kempa, 2002; Sozbilir, Akilli, Yasar & Dede, 2016).

The rivalry between the United States and the Soviet Union after the Second World War, and the resulting emphasis on education, precipitated the birth of the fields of science education and chemistry education. Chemistry education focused on mistakes made in theoretical learning in the 1970s, and then shifted to fighting misconceptions until the 1990s. This was soon followed by an emphasis on the teaching of concepts and, more recently, on teaching methods and techniques. The field of chemistry education then focused on teacher education and the use of information technology in chemistry classes, eventually becoming the well-established area of expertise that it is today (Jorde & Dillon, 2012; Sozbilir et al. 2016; Sozbilir & Ayas, 2015). Until the 1990s, chemistry education research was relatively scarce in Turkey (Sozbilir, 2013). As part of a National Education Development project undertaken by Turkey's Institution of Higher Education (HEI) and the World Bank, departments of education in universities across Turkey were restructured, with radically transformed functions and objectives. After that, there was a considerable rise in research in the field of chemistry education in Turkey. As academics working in departments of education began to focus on teacher education and applied chemistry education, the area of chemistry education expanded and gained tremendous momentum, reaching an all-time high in the mid-2000s (Sozbilir, Kutu & Yaşar, 2013; Sozbilir & Ayas, 2015).

As the number of publications grew, a host of diverse studies was conducted. Researchers who are working on a certain topic encounter difficulties in accessing research on that topic, wasting time and energy trying to locate what they are looking for among a large collection of studies. It is thus increasingly significant that we ascertain existing needs in the field and drive future research accordingly. Therefore, a study that monitors trends in the field by closely examining the body of research on chemistry education and its results will empower researchers working in the field of chemistry education (Cohen, Manion & Morrison, 2007). Content analysis is considered a synthesis of research, and it plays a pivotal role in making research topics widespread, shaping future work, policy, and practice, and raising public awareness (Suri & Clarke, 2009). In that regard, reviewing chemistry education research using content analysis will be beneficial for researchers in allowing them to follow trends in the field, spot problem areas, determine a course of action and avoid repetitions.

Literature Review

When looking at the content analysis work conducted in chemistry education, a few recent studies can be observed (Akkus, Sari & Uner, 2012; Sozbilir; 2013; Sozbilir et al. 2016; Sozbilir et al. 2013; Teo, Goh & Yeo, 2014; Towns & Kraft, 2013; Ulutaş et al., 2015; Yavuz, 2017). Teo et al. (2014) conducted a content analysis by reviewing 650 experimental chemistry education articles published in 2004-2013. They concluded that the most studied topic was a conceptual change, and 52 % of the studies used the mixed research method. Furthermore, the most frequent sample group was university students, and the highest number of studies was carried out in the United States, with 48.6%. Sozbilir et al. (2013) examined 273 chemistry education articles published by Turkish academics in 67 national and international journals between 1999 and 2009. They reported that the most common topic concerned the impact of teaching methods on student achievement. The most frequent research method was the quasi-experimental design, and the most common data collection tool was achievement tests. Moreover, most samples comprised undergraduates with 31-100 being the most frequent sample size, and descriptive analytics was the most preferred data analysis method. Sozbilir et al. (2016) reviewed 1338 chemistry education articles published in 65 journals between 1997 and 2013, comparing articles published in Turkey and articles authored in English and published in international journals. They reported that although there has been a rise in the number of articles published in Turkey since 2000, Turkish academia has had difficulty producing studies of international quality. A study conducted by Sozbilir (2013) found that national articles in chemistry education were largely based on quantitative research, while international articles were predicated on qualitative research. Moreover, national articles mostly relied on a single data collection tool, while international articles featured multiple tools. In another study, Ulutaş et al. (2015) conducted a content analysis of 193 chemistry education articles published in ten Turkish journals between 2000 and 2013. They concluded that most studies focused on the effects of teaching methods on success and most of these studies were based on quantitative research. They mostly used multiple-choice tests as a data collection tool and did not use pilot studies ahead of implementation, and the most common topics were fundamental chemistry and the particulate nature of matter. In a recent content analysis, Yavuz (2017) focused on graduate and doctoral theses on misconceptions in chemistry education between 2005 and 2015 in Turkey. The analysis, which looked at 64 theses, showed that most theses used scanning as a quantitative research method. They worked with samples comprising 50-100 middle school students and gathered data using concept testing and analyzed existing data using percentages/frequencies. Unlike graduate studies, Ph.D. studies mostly used the qualitative interview method to gather data. Akkus et al. (2012) carried out a content analysis by reviewing 75 graduate dissertations completed on chemistry education in Turkey between 2000 and 2010. They reported that most theses were based on quantitative research, used experimental designs, featured samples of 50-100 people, employed multiple-choice tests and analyzed data using t-tests. It can be seen that content analysis studies in the literature on teaching chemistry generally concentrate the same time (2000-2010). To our knowledge, there is not any study surveying the last 5-6 years. It can be argued that content analysis is

generally on articles and they use the same sample groups and data collection instruments.

Doctoral dissertations are significant studies in that they contribute to the development of their area as a scientific field; at the same time, they are based on original research and are more comprehensive and longer-term than other studies. Therefore, doctoral theses are expected to offer something new to the field. Doctoral theses are a rich source of data that allow researchers to see the distribution of research topics and methods in chemistry education. Furthermore, they provide an up-to-date overview of the field and give information on how trends have changed over time. Calık et al. (2008) and Kuçukozer (2016) reviewed doctoral theses on science education; Gurel et al. (2017) reviewed doctoral theses on physics education; Karadag (2009) examined PhD theses on educational sciences, and Kozikoglu and Senemoglu (2015) analyzed doctoral theses on educational programs and teaching. However, to our knowledge, no such study on doctoral theses in the field of chemistry education. Therefore, there is a need to explore and report on the changes and existing trends in chemistry education. Thus, this study aims to conduct a content analysis of the doctoral theses completed in chemistry education in Turkey. The author aims that this study will offer guidance to researchers and graduate/Ph.D. students who plan to work in chemistry education. This study aims to conduct a content analysis of doctoral dissertations carried out in the field of chemistry education within the last twenty years (1999-2019) after the restructuring of departments of education in Turkey. The study reviews doctoral theses in chemistry education concerning their topics, methods, university, distribution over the years, the teaching approach used, which chemistry topics they focus on, sampling, data collection tools and data analysis methods. For this purpose, the study seeks answers to the following research questions.

- How are doctoral dissertations in chemistry education in Turkey distributed over the years?
- What are the main problem statements explored in doctoral theses in chemistry education in Turkey?
- What are the common learning/teaching approaches utilized in doctoral theses in chemistry education in Turkey?
- What are the oft-studied chemistry topics in doctoral dissertations in the field of chemistry education in Turkey?
- What are the research methods/designs frequently employed in doctoral theses in chemistry education in Turkey?
- What are the sample groups and sample sizes commonly observed in doctoral theses in the field of chemistry education in Turkey?
- What are the common data collection tools in doctoral theses in chemistry education in Turkey?

- What are the common data analysis methods in doctoral theses in chemistry education in Turkey?

Method

Research Design

This study was conducted using the qualitative research method of document review. The main objective of document review is the study of written documents that contained information about the situation or problem that is being studied, and the analysis of the said documents with a view to inferring meaning from them (Merriam & Tisdell 2015; Yıldırım & Simşek, 2013).

Research Sample

This study relied on a comprehensive scan of the Turkish Higher Education Institution (HEI) database for studies conducted after the year 1999, as it was assumed that there was a strong rise in the number of thesis publications in the field of education following the restructuring of departments of education in Turkey (1998). Keywords, such as "chemistry education", "chemistry, education and teaching" and "chemistry teaching" were used on the HEI database, with "Ph.D." selected as the type of thesis. The search was repeated by selecting the department as "secondary education science and math", "math and science", and "primary school science education", also adding keywords, such as "chemistry education", "chemistry", and "chemistry teaching". Similar searches were conducted using English words. In total, 186 doctoral dissertations were found, and some of them were removed from the collection for being off-topic. Some theses could not be accessed due to restrictions. Some theses were accessed using the library of Artvin Çoruh University, as these dissertations were archived by the Turkey Document Management System (TÜBESS). As a result of these efforts, 168 doctoral theses were included in this research, with 162 of them reviewed in full and six reviewed on the basis of information provided on their abstracts (year, university, and objective) due to limitations on accessing the full texts. References contained a list of the theses accessed.

Research Instruments and Procedures

An analysis of these dissertations was conducted using the "Publication Classification Form" developed by Sozbilir, Kutu, and Yasar (2012). Many changes were made to this form, which was used extensively in a variety of studies. The form, which was revised for this particular study, consisted of nine categories that addressed the questions posed by this research (Appendix-1). The first two categories included the university at which the thesis was published and the year of publication; the third category featured the purpose or problem statement of the thesis (e.g., learning/teaching, teacher education, concept analysis, education/teaching problems, attitude/perception, curricula, test/criteria development and nature of science). The fourth category answered the question of which teaching/learning approach was used in the thesis (5E learning model, conceptual change approach, argumentation-based

instruction, problem-based learning, computer-assisted instruction and active learning) The fifth category concerned the subject of the research, with research design explored in the sixth category, sampling properties in the seventh, data collection tools in the eighth, and data analysis methods in the ninth.

Data Analysis

The documents analyzed as part of this study were Ph.D. theses completed in chemistry education in Turkey between 1999 and 2019. The theses were subjected to descriptive content analysis. Descriptive content analysis is a study that is conducted with the purpose of determining trends and developments by reviewing research conducted in a specific field over a long time (Calik & Sozbilir, 2014). Content analysis is a method used to evaluate for a certain publication piles (Falkingham & Reeves, 1998). The study analysed doctoral theses in chemistry education concerning their topic, university, methods, the teaching approach used, sampling, data collection tools and data analysis methods.

Many theses were classified together with an expert academician who had conducted some content analysis studies before. Afterwards, the researcher and the domain expert coded ten theses one by one and the consistency of the coding has been compared to understand if the researcher learned the categorization appropriately. The consistency was over 90% between the two coders and uncertainties were cleared. Then, the 168 doctoral theses that were analyzed were categorized again by the researcher himself after a month-long interval to confirm the validity of the content analysis. There was a 94% compatibility between the researcher's two reviews. Coding was highly aligned (Miles & Huberman, 1994). The coding differences between the two categorizations of the researcher were then reviewed again, and a field expert was consulted in cases where the researcher faced difficulty making categorization decisions. The data that were gathered as a result of the content analysis were saved in a Microsoft Excel file. The data were checked again to prevent double entries or loss of data and were exported to SPSS 18.0 for analysis. Subjected to a descriptive analysis, the results were presented in the form of frequency (f) - and percentage (%)-based graphics and tables.

Results

The distribution of the 168 theses examined in this study between 2001-2018 presented below in figure 1.

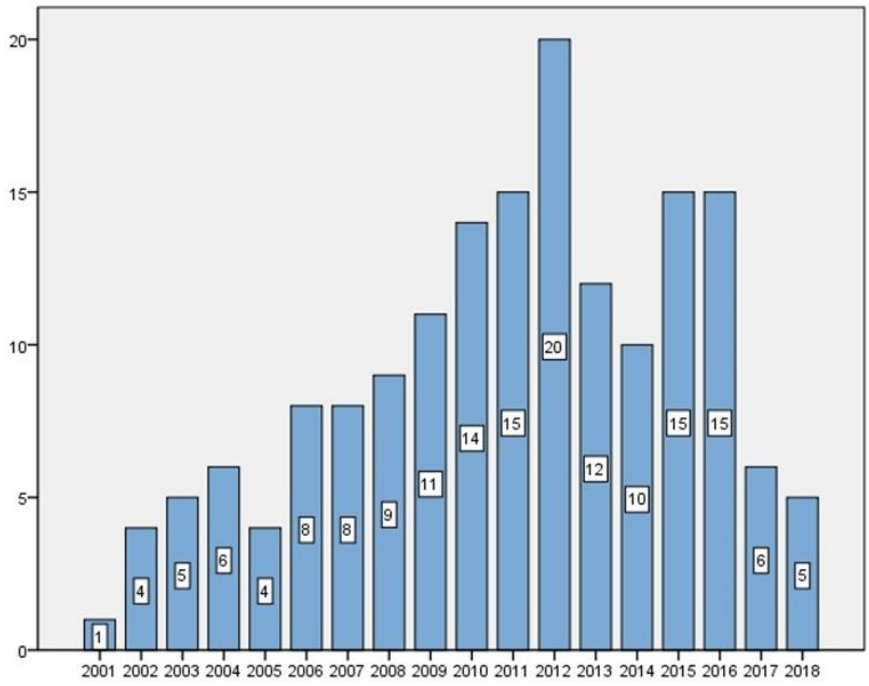

Figure 1. *Distribution of PhD Theses in Chemistry Education over the Years (1999-2019)*

As can be seen form the figure 1 during the 2000-2019 period, the first doctoral dissertations in the field of chemistry education began to be published in 2001-2002, and the number of theses published in a year reached a peak in 2012. There has been a downward trend in subsequent years. No doctoral thesis was published in the year 2019, the year of publication for this study.

The distribution of the theses by subject in Table 1 showed that most dissertations mainly dealt with improving teaching and learning, and they overwhelmingly concentrate on the effects of instructional methods on students' achievement.

Table 1

Distribution of the PhD Theses by Subject

Subject	f	%
Instruction	137	81.5
Teaching as a profession	9	5.4
Curricula work	5	3.0
Teacher education	5	3.0
Material development	3	1.8
Determining attitude/interest/motivation	3	1.8
Others	6	3.6
Total	168	100.0

Table 1 demonstrated that the majority of PhD theses in the field of chemistry education focused on the effects of the instructional method on student success.

Figure 2 shows which instructional methods were used in Chemistry Education PhD theses.

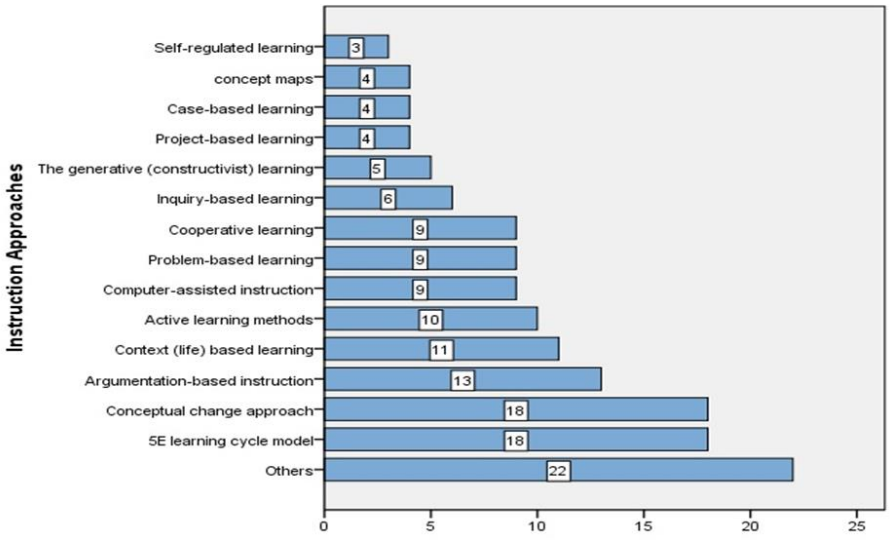

Figure 2. *Instruction Approaches Applied in Doctoral Dissertations in the Field of Chemistry Education*

The most commonly used teaching methods were the 5E learning model (18) and the conceptual change approach (18). They were followed by argumentation-based instruction (13), context (life) based learning (11), active learning methods (10), cooperative learning (9), problem-based learning (9), computer-assisted instruction (9), inquiry-based learning (6), generative learning approach (5), project-based

learning (4), concept maps (4), case-based learning (4), self-regulated learning (3), and other instructional methods (22).

Table 2 shows on which chemistry topics the theses were based on. It can be seen from Table 2 that studies concentrated on high-school chemistry curriculum and the instruction is based on high-school chemistry curriculum subjects. The theses were mostly on topics, such as acids-bases, chemical equilibrium, solutions, electrochemistry, chemical bonds, gases and reaction rate, where misconceptions are frequent. Organic chemistry topics, which mainly require knowledge level were not included in the theses at all. Some dissertations dealt with multiple chemistry topics. In addition, the instruction in some of the dissertations was based on different chemistry experiments.

Table 2

Distribution of the PhD Theses by Chemistry Topic

Chemistry Subject	**f**	%
Acids-Bases	16	10.5
The Structure of Matter	13	8.6
Multiple Chemistry Topics	13	8.6
Chemical Equilibrium	11	7.2
Solutions	10	6.6
Chemical Bonds	9	5.9
Electrochemistry	9	5.9
Gases	8	5.3
Using Experiments	7	4.6
Reaction Rate	7	4.6
Physical and Chemical Changes	6	3.9
Environmental Chemistry	5	3.3
Thermodynamics	5	3.3
Mixtures	4	2.6
Atoms and the Periodic System	4	2.6
Solubility Equilibrium	4	2.6
Chemical Reactions	3	2.0
Others	18	11.8
Total	152	100.0

Table 3 below shows the research designs used in doctoral dissertations published in chemistry education in Turkey between 1999-2019. According to Table 3, the most frequently used method in the theses was a quasi-experimental design, which is generally used in instructional activities. However, there are also some studies on instructional activities using a mixed method design. Furthermore, it can be seen that studies on the teaching profession and curriculum were mainly carried out using qualitative design.

Table 3

Research Designs and Methods Used in PhD Theses

Research Design		**f**	**%**
Quantitative	Quasi-experimental	86	52.8
	Pre-experimental	8	4.9
	Descriptive survey	4	2.5
	Correlational survey	3	1.8
	Subtotal	101	62.0
Qualitative	Case study	29	17.8
	Action research	4	2.5
	Document review	1	0.6
	Subtotal	34	20.9
Mixed	Explanatory mixed design	3	1.8
	Triangulation mixed design	15	9.2
	Embedded mixed design	10	6.1
	Subtotal	28	17.1
	Total	160	100.0

Figure 3 contains a graph that shows the distribution of various research methods over the years.

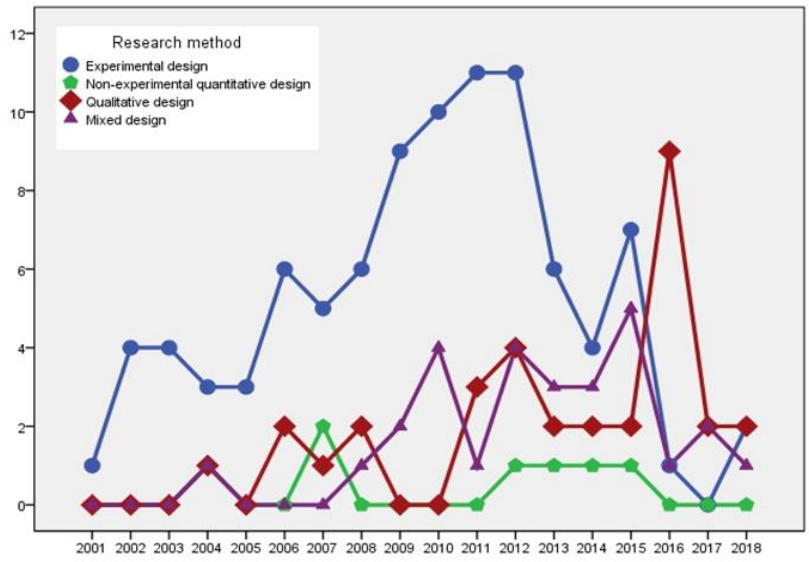

Figure 3. *Distribution of Research Methods Used in PhD Theses over the Years*

The graph demonstrates that experimental designs have not been used as frequently in recent years, while there has been a growing interest in qualitative and mixed designs. The fact that studies on chemistry teaching initially concentrated on finding misconceptions and correcting them led to the frequent use of experimental

designs in the early years. It can be seen that educational studies have recently headed for qualitative and mixed research designs because education is a social science. Using mixed research design, educational studies can be carried out both quantitatively and qualitatively in a more holistic way. It can be argued that the new trend is a mixed approach.

Figure 4 shows the distribution of sample groups that were commonly studied in dissertations.

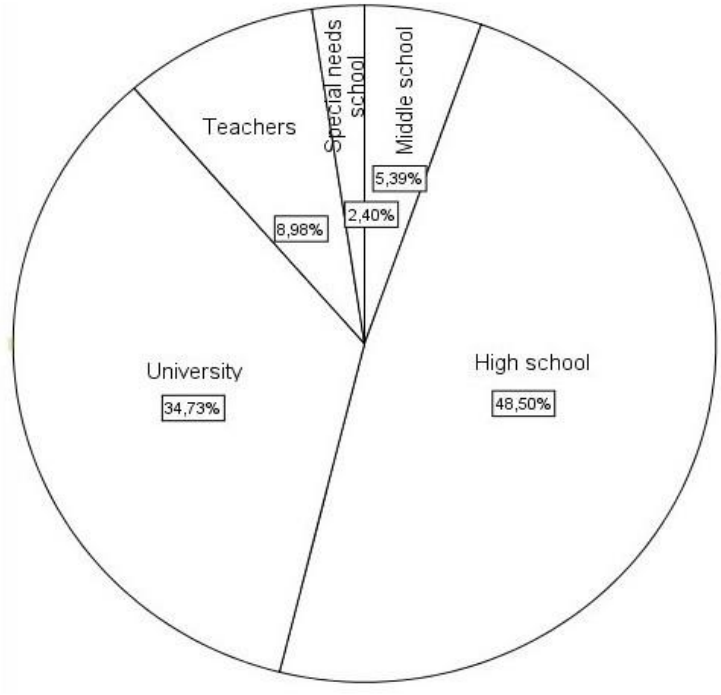

Figure 4. *Sample Groups Studied in PhD Theses on Chemistry Education*

As can be seen from figure 4, researchers gravitate towards a high school level because the topics they chose were mostly formed the high-school chemistry curriculum. University students formed the second-largest sampling group because of convenience sampling for instructional activities. Chemistry teachers were not preferred much as a sample group due to teacher education and curriculum being studied less frequently in dissertations.

The Figure 5 shows the sample sizes commonly chosen in PhD theses in the field of chemistry education in Turkey.

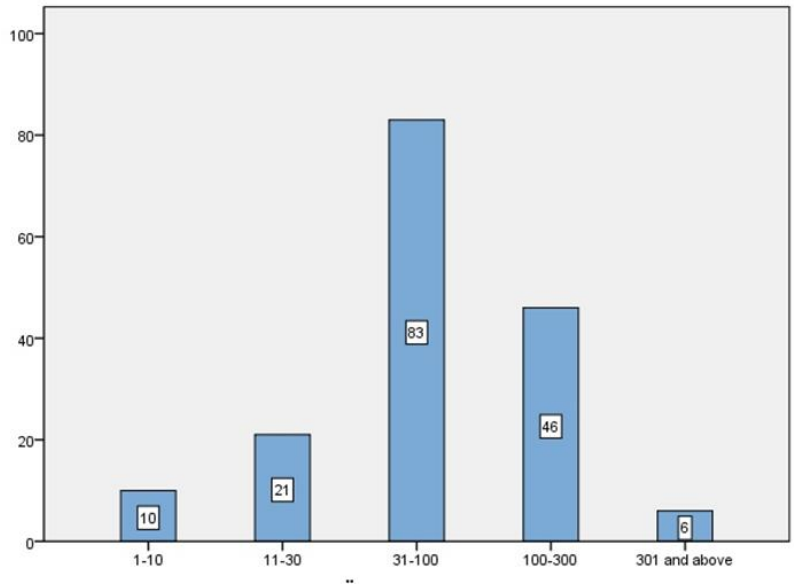

Figure 5. *Sample Sizes Commonly Preferred in PhD Theses in Chemistry Education*

The graph demonstrates that the most common sample size was 31-100 in line with instructional activities carried out in experimental designs. This may be a result of the size of the two classes, namely the experimental and control groups, because the average classroom size was between 30-40. That some experimental studies were conducted with 3-4 classes, and some of them were conducted with more crowded university samples might be responsible for the use of sample sizes of 100-300 to a relatively large extent. That the number of qualitative studies using interviews was limited might account for the limited number of small sample sizes (1-10). Similarly, that survey studies with large sample sizes were preferred less in the theses might be the reason why sample sizes over 300 were used so infrequently.

Figure 6 exhibits the number of data collection tools used in the PhD theses, that have been published in chemistry education over the last two decades and that were subjected to the content analysis as part of this study.

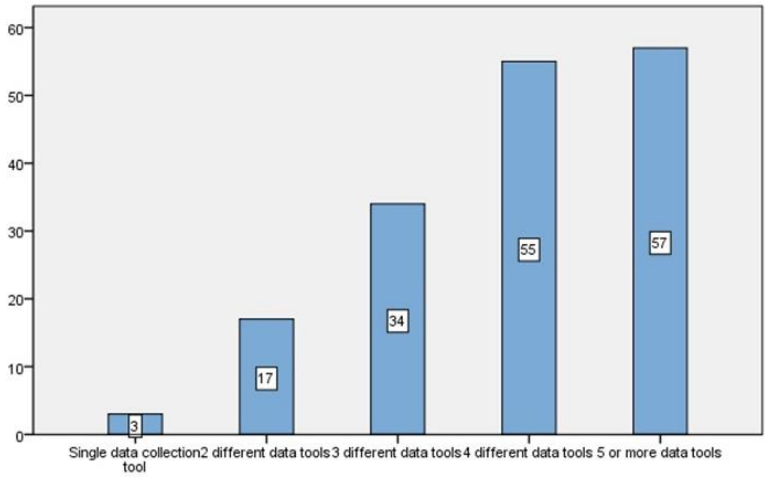

Figure 6. *Number of Data Collection Tools Commonly Employed in PhD Theses*

It is to be expected for PhD dissertations, which are normally comprehensive and long-term studies, to use different measurement tools. As can be seen from Figure 6, most of the theses covered in this study used four or more data collection tools. In addition to achievement tests, instruments, such as attitude scale, scientific process skill scale and interview forms, were used together.

Table 4 displays the types of data collection tools utilized in doctoral dissertations completed in chemistry education within the last twenty years (1999-2019) in Turkey. The 162 theses that were subjected to the content analysis used 635 data collection tools. It can be understood from Table 4 that, on average, four different scales were used for each thesis. The most commonly used data gathering instrument was the interview. The depth of learning can be assessed qualitatively using interviews. The dissertations dealt with the effects of instructional activities on achievement to a large extent as well as their effects on student's attitudes about the course. The level of how much learning took place was measured using concept tests and achievement tests. It can also be understood that in a considerable number of studies, the effect of instruction on scientific process skill was investigated besides its effects on achievement and attitudes. It was seen that interviews for different purposes were used in PhD dissertations as well as in many other studies.

Table 4

Data Collection Tools Commonly Used in PhD Theses

Data Collection Tools	f	%
Interview	113	17.8
Course-Based Attitude Scale	81	12.8
Concept Testing	70	11.0
Achievement Tests	69	10.9
Observation	66	10.4
Scientific Process Skill Scale	56	8.8
Surveys	46	7.2
Method-based Attitude Scale	16	2.5
Logical Reasoning Test	13	2.0
Written Opinions	13	2.0
Attitude Scale on Nature of Science	10	1.6
Others	82	12.9
Total	635	100.0

Figure 7 shows the number of data analysis methods used in the PhD theses reviewed by this study. It can be seen from Figure 7 that different data analysis methods were used in the studies as a result of using different data collection instruments.

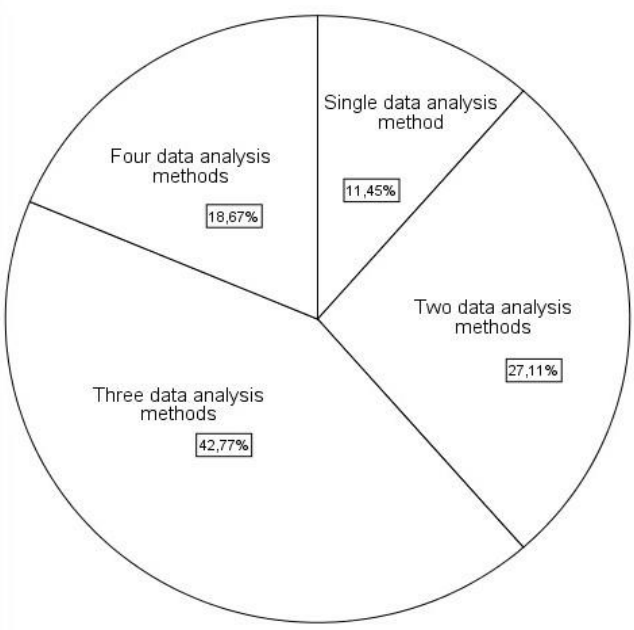

Figure 7. *Number of Data Analysis Methods Commonly Used in PhD Theses*

Table 5 shows the data analysis methods frequently used in the doctoral dissertations reviewed as part of this study. The most commonly utilized method was predictive analysis as a result of the dominance of quantitative studies. Qualitative data analysis instruments were also used considerably. Descriptive statistics, which can be used in all kinds of studies, were also utilized to a large extent. Among predictive analytics methods, t-tests were the most commonly used method, followed by the ANOVA/ANCOVA method. The most frequently used qualitative analysis method was content analysis.

Table 5

Data Analysis Methods Commonly Used in PhD Theses

Data analysis method		**f**	**%**
Descriptive	frequency and % tables	93	20.9
Predictive	t-tests	72	16.2
	ANOVA/ANCOVA	70	15.7
	Mann-Whitney U/Wilcoxon Signed-Rank Test	33	7.4
	MANOVA/MANCOVA	31	7.0
	Correlation	14	3.1
	Regression	8	1.8
	Subtotal	228	%51.2
Qualitative	Content analysis	70	15.7
	Descriptive analysis	43	9.7
	Subtotal	113	%25.4
	Others	11	2.5
	Total	445	100.0

Discussion and Conclusion

Doctoral dissertations are original, comprehensive and long-term studies that contribute to the development of their area as a scientific field. With a view to understanding the state of affairs in the field of chemistry education and offering guidance to researchers by highlighting trends, 168 PhD theses published in the last twenty years (1999-2019) have been subjected to content analysis concerning their year of publication, subject and purpose, research method, data collection tools, sample groups and data analysis methods.

This study has found that doctoral dissertations in the field of chemistry education in Turkey emerged in the years 2001-2002 and peaked in number in 2012 with 20 theses published. However, a decline has been observed in subsequent years. In 2018, this number fell to four dissertations in total; moreover, as of March 2019 -- the date of completion for this study--no new dissertations have been published this year. This study has observed the phenomenon, already established in several studies (Sozbilir; 2013; Sozbilir et al., 2013; Ulutas et al., 2015; Yavuz, 2017), that interest in the field of chemistry education research rose after the 1998 restructuring of departments of

education by HEI concerning their framework and functioning. Given that PhD theses are long-term academic works that take at least 3-4 years to complete, it is meaningful that the first theses over the last twenty-year period emerged in 2001 and 2002, or 3-4 years after the 1998 restructuring policy. It is believed that most academics working in departments of education focused on pure chemistry and did not deal with chemistry education and teaching. It can be asserted that the decline in the number of theses published in recent years stems from the oversaturation of this area of research, as well as the difficulty of attracting students to chemistry education departments, the closures of some departments, and a fall in employment opportunities in the field. Although there is a sufficiently large group of academics and researchers at universities, that fewer students are now applying to and enrolling in PhD studies means that the number of theses has inevitably decreased due to reasons, such as the termination of ÖYP (Teaching Staff Training Program), which was supported by YÖK (The Council of Higher Education).

Looking at the distribution of chemistry subjects that the theses dealt with, most studies focused on the teaching of various chemistry topics These studies mostly developed or adapted a teaching method and explored its effects on the success of students in a given chemistry subject. Since PhD theses are comprehensive in nature, these studies focused on the effects of instruction on success as the main problem, while examining other criteria, such as attitude, scientific attitude, and opinion on the nature of science. The content analysis conducted as part of this study conducted the problem statements when categorizing Ph.D. theses by research topic. Apart from instruction, other topics included teaching as a profession (5 percent), curricula study (3 percent), teacher education (3 percent), material development (2 percent), attitude/interest/motivation tests (2 percent) and content analysis (1 percent). The results of this study slightly diverge from those obtained by Teo et al. (2014) and Sozbilir et al. (2013) concerning umbrella research subjects. These studies similarly featured instruction as a prominent research topic among chemistry education articles, but the frequency of this topic was much smaller (20-30%) compared to the findings of this study; in addition, these previous studies found that learning was as common as instruction among the research topics of articles published in chemistry education. The PhD theses reviewed by this study were concerned with both learning and instruction. The majority of the theses set out to determine the level of learning in sample groups before focusing on ways to develop teaching methods that would enhance learning. As instruction research takes a long time to design, implement and analyze, field researchers might have viewed them as more appropriate for PhD-level work. This study has found that PhD studies in Turkey have tended to be confined in a narrow thematic area. Most studies, therefore, are duplicates of one another or adaptations of a given concept to a different subject matter. This study finds that it is necessary for researchers to shift their focus to original themes and define new problem statements. Teachers are a crucial element of chemistry teaching as they are the actual practitioners of teaching chemistry at schools. Teacher training will enhance chemistry teaching, as well. For high-quality education, high-quality teachers are essential. Therefore, more studies should be conducted on teacher training. Another significant component of chemistry education is the chemistry teaching curriculum. Curricula determine what will be taught, how it will be taught and how the teaching will be assessed. To improve the quality of chemistry teaching, the quality of the chemistry curriculum should be

improved. There should be more PhD dissertations on chemistry curriculums, which are supposed to contribute to chemistry teaching a lot. Furthermore, there is a pressing need for studies on the assessment and evaluation approach in chemistry teaching.

Looking at the instructional approaches/strategies studied in the 137 theses coded as instruction research and others focusing on teacher education and material development (145 theses in total), the most common approaches were conceptual change instruction and the 5E learning model. These were followed by argumentation-based instruction, cooperative learning, problem-based learning, context-based instruction, and various active learning approaches. Ulutas et al. (2015) and Teo et al. (2014), report the conceptual change instruction method as the most common teaching approach studied in graduate programs. As on international scale, studies in Turkey on chemistry teaching initially concentrated on concept analysis. In the first few years of the two-decade timeframe designated by this study, the PhD theses that were subjected to content analysis focused mostly on the 5E learning model, while more recently, the argumentation-based teaching approach and the context-based instruction strategy began to attract more academic interest. Thanks to the influence of constructivist teaching methods, activities in which students do and experience things have grown in importance. Similarly, academic studies have developed teaching methods that would nurture this approach. To grasp the attention of new generations, there is a need for further studies on the use of technology in chemistry teaching. With the increasing use of smart boards and tablet computers, more studies should be conducted on the use of such electronic devices in chemistry teaching. In parallel with the widespread use of YouTube and other social media platforms, new studies can contribute to the development of chemistry education by focusing on the applicability of chemistry teaching using these platforms.

Looking at the distribution of topics explored by 150 theses subjected to content analysis (Table 2), acids & bases featured as the most common chemistry subject. This was followed by the structure of matter, chemical equilibrium, miscellaneous general chemistry subjects, solutions, chemical bonds and electrochemistry. This finding is in line with that of Ulutas et al. (2015) and Sozbilir et al. (2016), who found that chemistry education articles frequently focused on the particulate nature of matter, basic chemistry, reaction rate, chemical bonds, acids & bases, and solutions. These topics tend to be associated with misconceptions that are frequently mentioned in the literature. Therefore, it is meaningful that these topics have been featured in studies that aim to enhance conceptual learning. The number of studies on the concept of mol, which is one of the topics that students have the most difficulty understanding, is inadequate and more studies should be conducted on this topic. It can be argued that topics, such as a periodic table, carbon chemistry and organic chemistry, which require knowledge level, are not preferred much. There is a need for further studies to develop teaching materials and put these materials at teachers' and students' service for these topics, which constitute an important part of the chemistry curriculum. Moreover, it is significant to note that there is no PhD dissertation on nanotechnology in Turkey, which is a very important concept in the science world, yet, it has not been covered adequately in the chemistry curriculum yet. Still, there are some master's theses on the subject, and to have a place in the international science and technology world, PhD dissertations in the field of nanotechnology should be supported. Furthermore, to our

knowledge, environmental chemistry, sustainability, fossil fuels, renewable energy and health and safety in chemistry topics, which have recently been included in the chemistry curriculum, have not been studied yet. Studies on these topics will also benefit chemistry teaching.

Many of the theses that were reviewed by this study were conducted using qualitative designs and more than half were found to have utilized a quasi-experimental design (53 percent). Among qualitative designs, case studies were frequently employed, while the use of mixed designs -- despite being in the minority -was observed in nearly one- fifth of the studies. Among mixed designs, triangulation was the most commonly used method. The pre-experimental design, survey designs, action research, document review, and the explanatory mixed design were rarely preferred as research methods. On the other hand, methods, such as the strong experimental design, single-subject design, ex post facto design, comparative design, cultural analysis, and theory building, were not utilized in any of the theses. These results are similar to those of the existing body of research in that quantitative studies are quite frequent (Sozbilir et al. 2013; Ulutas et al., 2015; Yavuz, 2017), although there are diverging aspects. Several studies (see Sozbilir et al. 2013; Ulutas et al., 2015; Yavuz, 2017) have shown non-experimental quantitative methods to be the most common, while this study has found that experimental designs are more often preferred as the research method. Since PhD theses are more comprehensive and are required to present more reliable results, it is expected that they would feature experimental designs more frequently. Interventional studies provide students with a novel opportunity for better learning. Experimental designs allow the researcher to statistically compare the new method with the old method (McMillian & Schumacher, 2010). Thus, since most of the PhD theses reviewed in this study focused on instruction, they frequently used experimental designs. Looking at the distribution of research designs over the years (Figure 4), we observe that experimental designs were used more often in the first years, while qualitative designs and mixed designs emerged more recently. Mixed method research has apparently been the most common design since 2010, as reported by Kuçukozer (2016) on PhD theses on science education, and by Kozikoglu & Senemoglu (2015) on educational programs and instruction. These results are consistent with the findings of this study. According to the study conducted by Teo et al. (2014), mixed designs were the most common research method. To obtain more reliable results, various data collection tools need to be used in coordination with each other. Combining quantitative and qualitative approaches ensures a better understanding of the research problem and more reliable results (Creswell, 2014). The rise of mixed designs in research in Turkey might have been influenced by international studies. Qualitative research requires more effort and serves to interpret facts in their natural environment and with a holistic approach (Creswell, 2014). In fact, more qualitative studies are needed in the social science field, such as chemistry education.

Concerning sample groups, high school students were the most common, followed by undergraduates. Other sample groups included chemistry teachers, middle school students and students with special needs. This result is compatible with the results of other studies in the field (Sozbilir et al. 2016; Sozbilir et al. 2013; Teo et al. 2014; Ulutas et al., 2015; Yavuz, 2017). Since chemistry subjects are taught at the high school level, academic studies should focus on this context. The reason why undergraduates were

a common sample group is the ease with which researchers, who are often resident lecturers at universities, can find students to interview or invite to an experiment. Due to the lack of activity in the field in recent years, special needs schools were also included in the theses as sample groups. In line with the other results of the study, the most common sample group size was 31-100 people, followed by 101-300. This result is anticipated as the quasi-experimental design, the most common research method used in the PhD theses that were reviewed by this study makes use of control groups and experimental groups that are compared with each other. The sample size is significant for the reliability and external validity of qualitative studies (Creswell, 2014). This study has found that some dissertations utilized smaller sample groups than required.

Concerning the number of data collection tools used, the most common scenario was the use of five of more data collection tools. This was followed by four and three tools, respectively. There were also a small number of cases in which two different tools and a single tool were utilized. Studies in which different types of data support each other are considered to have higher validity (Fraenkel et al., 2012). Doctoral dissertations are required to be comprehensive and valid studies. Thus, raising the number of data collection tools to ensure the validity and reliability of the results and to expand the scope of the study is expected and appropriate. This study has found that theses that made use of a single data collection tool were content analysis studies that were conducted using document review. Similarly, studies on curricula and teaching as a profession were carried out using fewer data collection tools. Looking at which data collection tools were preferred more often (Table 4), we see that concept testing and achievement tests to measure academic performance were the most common, in accordance with the problem statements of the studies. Some studies focusing on instruction employed measured learning using achievement tests, while other studies used concept testing for the same purpose. Thus, the use of concept testing and achievement tests is proportionate to the number of studies on instruction and teaching. Interviews were also used frequently to collect data. Approximately 70 percent of the dissertations made use of interviews for data collection purposes. Most of them were in the form of semi-structured interviews, while some studies preferred a structured interview format. Interviews can be leveraged both to collect qualitative data and as a means of supporting quantitative research. This explains why they are one of the most popular data collection tools. Similarly, tests to measure attitude towards chemistry courses and scientific attitude tests also feature prominently as data collection tools. Although used infrequently, surveys developed for a variety of reasons were also employed in some studies. These findings are compatible with studies in chemistry education, which report that the most common data collection tools are achievement tests and interviews (Sozbilir et al. 2016; Sozbilir et al. 2013; Ulutas et al., 2015; Yavuz, 2017). Data collection and analysis can also be effectively conducted using multiple-choice achievement tests and Likert-type attitude scale. Interviews can also provide a rich source of data (De Jong, 2007). When the first PhD dissertations appeared in chemistry education, the studies concentrated on concept analysis, and as a result, the most commonly used assessment tools were concept tests and achievement test. Later, qualitative data collection instruments became more prominent because education is a field of social science. With the interview method, rich data can be obtained (De Jong, 2007). Interviews can be applied in both qualitative

and mixed method studies and even in experimental studies. Accordingly, interviews have become an integral data collection tool for PhD dissertations. When the data collection instruments in dissertations are analyzed, it can be seen that psychological scales, which are inherent in the field of education, are not developed in the field of chemist education. In chemistry education, there is a growing need to develop new scales specifically designed for chemistry education and long term observations in the natural environment of the chemistry lessons. New data collection tools can be developed for laboratory experiments rather than achievement in chemistry courses, for which laboratories are essential.

Methods used in the PhD studies for data analysis were compatible with the research design, and the most common method for data analysis was predictive analytics. Predictive analyses are useful for exploring relationships between variables (McMillian & Schumacher, 2010). In studies based on experimental designs, it is more appropriate to analyze quantitative results using predictive analytics. Approximately half of the PhD theses made use of predictive data analysis. The most common predictive analytics methods were t-tests and variance analysis. Non-parametric tests and multivariate analyses of variance were also among the frequently utilized predictive analytics methods. The reason for the use of these analyses may be the aim of explaining the relationship between variables investigated a study in a more explicable way and the easier interpretation of the results. It was seen that researchers rarely used such advanced statistical methods as correlation, factor analysis and regression analysis, which may be a result of their not having a good knowledge of statistics. For high-quality dissertations, different statistical techniques should be used in combination.

Quantitative analysis methods were followed by qualitative data analysis methods. Content analysis was the most common qualitative analysis method. Aside from qualitative and predictive analyses, frequency and percentage-based tables are also commonly used as data analysis methods. Similar results were also reported in other studies (Akkus et al. 2012 Sozbilir et al. 2016; Sozbilir et al. 2013). This study found that nearly 90 percent of the PhD theses that were reviewed employed more than one data analysis method. To improve the validity and reliability of studies, different data collection instruments and data analysis methods should be used to enrich the theses. This is crucial for the quality, validity and reliability of research.

In conclusion, a content analysis of the doctoral dissertation conducted in Turkey in the field of education within the last two decades (1999-2019) is herewith presented to researchers and decision-makers who will chart the future course of scientific policies. Taken as a whole, the results show that the authors of the PhD theses failed to adequately define the research methods that they employed. Thus, this study recommends that more emphasis be placed on graduate courses that teach research methods, incorporating more practice sessions. There is also a need, in keeping with international trends, to focus more on mixed method research, and to increase the number of qualitative studies, which do a better job of exploring educational environments in a natural manner. As stressed by Towns (2013) and Towns and Kraft (2011), lab-based instructional approaches, which are crucial in chemistry teaching, should be developed and researched; in addition, long-term qualitative studies (e.g., action and longitudinal) in teaching environments should be conducted more

frequently. This study has observed that researchers tend to settle for easily accessible sample groups. It would therefore be more appropriate to conduct studies using various sampling methods. It can be said that the number of data collection tools and data analysis methods used in the PhD theses are adequate concerning ensuring validity and reliability. However, qualitative findings were often quantized using frequencies/percentages. Additional care should be taken to develop new ways of analyzing qualitative data and integrating various data types. The author aims that this study, which explores trends in the field of chemistry education, will help guide researchers and higher education planners in their efforts to improve and enhance instruction.

References

+Acar, B. (2008). *An active learning application based on constructivism for the subject of ?acid and bases? in high school chemistry lesson* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

+Agbulut, H. (2015). *A research on using the method of informing with short message in teaching some nuclear chemistry concepts* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Aglarci, O. (2014). *The effect of teaching based on explicit-reflective approach on prospective chemistry teachers' nature of science views* (Unpublished doctoral dissertation). Marmara University, Istanbul.

+Aka, E.İ. (2012). *The effect of problem-based learning method used for teaching acids and bases on different variables and students? views on the method* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Akın, F.N. (2017). *The nature of interplay among components of pedagogical content knowledge in reaction rate and chemical equilibrium topics of novice and experienced chemistry teachers* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Akkus, H. (2004). *The Effect of conceptual change texts on chemical equilibrium achievement* (Unpublished doctoral dissertation). Gazi University, Ankara

Akkus, H., Sari, S. N. & Uner, S. (2012). The content analysis of graduate theses written between 2000 and 2010 in the field of chemistry education. *Procedia-Social and Behavioral Sciences, 47*, 729-733.

+Akkuzu, N. (202). *Determination of professional competence levels of chemistry pre-service teachers* (Unpublished doctoral dissertation). Dokuz Eylül University, Izmir.

+Akpınar, İ.A. (2010). *The preparation, implementation and evaluation of active learning activities based on constructivist approach in teaching solutions in chemistry course* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Aksu, Ş. (2010). *The effect of active learning method on preventing misconceptions in the subject of mole in chemistry programme in high school* (Unpublished doctoral dissertation). Dokuz Eylül University, Izmir.

+Alkan, F. (2012). *Effect of self-directed learning on the students' success, learning readiness, attitudes towards laboratory skills and anxiety in chemistry laboratory* (Unpublished doctoral dissertation). Hacettepe University, Ankara.

+Alsan, E.U. (2009). *The effect of learning style preferences, self-regulated learning and motivation factors on pre-service chemistry teachers? academic achievement* (Unpublished doctoral dissertation). Hacettepe University, Ankara.

+Altay, C.A. (2018). *The effect of context based learning on the 9th grade students' success in chemical sciences unit attitudes towards chemistry class and perception of the nature of science* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Alyar, M. (2018). *The effect of model, animation and seven principles used together with cooperative learning model on learning some chemistry subjects* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Ari, E. (2008). *The impact of a constructivist learning approach and learning styles on the achievement, scientific process skills and attitutes of preservise science teachers through general chemistry laboratory* (Unpublished doctoral dissertation). Marmara University, Istanbul.

+Aslan, A. (2015). *Design of intoeractive out-of-class chemistry environment and evaluation of its effectiveness* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Aslan, S. (2010). *The effect of argumentation-oriented teaching approach on the improvement of their top scientific process and critical thinking among high school 10. class students'* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Aydemir, N. (2012). *Effectiveness of 5e learning cycle model on high school students understanding of solubility equilibrium concept* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Aydın, A. (2004). *A comparative study of secondary education chemistry curriculum of several countries and a new proposal of curriculum for Turkey* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Aydın, S. (2012). *Examination of chemistry teachers topic-specific nature of pedagogical content knowledge in electrochemistry and radioactivity* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Ayyıldız, Y. (2012). *Development, application and evaluation of an active learning material based on constructivist approach in the subject of chemical reactions and energy in the high school chemistry* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

+Azizoglu, N. (2004). *Conceptual change oriented instruction and students' misconceptions in gases* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Baran, M. (2013). *The effect of context- and problem-based learning on teaching thermodynamics* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Baykan, P. (2015). *Being development implementation and evaluation of the sample in-service training activity based on chemistry teachers' needs of using interactive whiteboard* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Bayır, E.B. (2008). *Teacher education in the light of new tendencies in science curriculum: Inquiry-based chemistry teaching* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Bayrak, R. (2007). *Teaching solids by problem based learning* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Bektaş, E. (2011). *The effect of 5E learning cycle model on tenth grade students' understanding in the particulate nature of matter, epistemological beliefs and views of nature of science* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Bilgi, M. (2010). *The effect of computer assisted instruction on students' chemistry achievement in the teaching of the subject of oxidation-reduction* (Unpublished doctoral dissertation). Marmara University, Istanbul.

+Bilgin, İ. (2002). *The Effect of cooperative learning approach based on conceptual change conditions on students' understanding of chemical equilibrium* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Bilir, V. (2015) *The effects of the perceptions of the students at faculties of education and science towards conceiving corrosion – environment relationships on their environmental consciousness* (Unpublished doctoral dissertation). Gazi University, Ankara.

Calık, M., & Sozbilir, M. (2014). Parameters of content analysis. *Education and Science, 39*(174), 33-38. doi: 10.15390/EB.2014.3412

+Calık, M. (2006). *Devising and implementing guide materials related to solution chemistry topic in Grade 9 based on constructivist learning theory* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

Calık, M., Ünal, S., Coştu, B., & Karataş, F. Ö. (2008). Trends in Turkish science education. *Essays in Education,* 23-45.

+Cam, A. (2009). *Effectiveness of case-based learning instruction on students' understanding of solubility equilibrium concepts* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Can, H.B. (2013*). Effect of structuring cooperative learning based on conceptual change approach on students' understanding of the concepts of mixtures and their motivation* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Can, Ş. (2004). *Researching the quality of chemistry education at the public and private high schools (the sample of Antalya city)* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Canpolat, N. (2002). *Investigation of effectiveness of conceptual change approach on understanding of chemical equilibrium concepts* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Capraz, C. (2016). *Teaching solid-liquid-gas states of some substances to students with intellectual disabilities in a secondary special sub-class through direct instruction method* (Unpublished doctoral dissertation). Ataturk University, Erzurum

+Celep, N. G. (2015). *The effects of argument-driven inquiry instructional model on 10th grade students' understanding of gases concepts* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Celik, A.Y. (2010). *An analysis of the influences of the teaching approach based on scientific argumentation on high school students' conceptual understanding, attitudes, and willingness for argumentation and the quality of argumentation* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Celik, S. (2009). *The influence of project based learning approach on pre-service science teachers? conceptions of the nature of science and technology and scientific process skills* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Cengiz, C. (2014). *The effect of reflective journals kept by pre-service science teachers on reflective thinking and achievement in general chemistry laboratory* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Cengiz, C. (2017). *Argumentation development of teaching skills: Case studies with preservice science teachers* (Unpublished doctoral dissertation). Marmara University, İstanbul.

+Cetin, P.S. (2009). *Effects of conceptual change oriented instruction on understanding of gases concepts* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Ceylan, E. (2008). *Effects of 5E learning cycle model on understanding of state of matter and solubility concepts* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Cidam, Z. (2011). *Ausubel's meaningful learning (presentation) method of preparation and implementation of appropriate material for the prevention of misconceptions in electrolysis and electrochemical battery units* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

+Cigdemoğlu, C. (2012). *Effectiveness of context-based approach through 5E learning cycle model on students' understanding of chemical reactions and energy concepts, and their motivation to learn chemistry* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

Cohen, L. Manion. L., & Morrison, K. (2007). *Research methods in education*. London: Routledge Falmer.

+Costu, B. (2006). *Determining students' conceptual change levels: Evaporation, condensation and boiling* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

Creswell, J. W. (2014). *A concise introduction to mixed methods research.* Sage Publications.

De Jong, O. (2007). Trends in western science curricula and science education research: A bird's eye view. *Journal of Baltic Science Education, 6*(1), 15-22.

+Demirci, T. (2015). *The effect of concept maps based-education methods in the subject of 'Protein synthesis' of biochemistry lecture on success of the students, determination and removal of misconceptions* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Demircioglu, H. (2008). *Developing instructional materials about the topic of 'states of matter' based on the context based approach for primary students teachers and probing their effectiveness* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Demirdağ, B. (2011). *Web assisted collaborative learning in inorganic chemistry* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

+Demirdögen, B. (2012). *Development of pre-service chemistry teachers' pedagogical content knowledge for nature of science: An intervention study* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Derman, E. (2007). *Chemistry student teachers' self efficacy beliefs and attitudes toward teaching profession* (Unpublished doctoral dissertation). Selçuk University, Konya.

+Dindar, A. Ç. (2012*). The effect of 5E learning cycle model on eleventh grade students conceptual understanding of acids and bases concepts and motivation to learn chemistry* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Dogar, Ç. (2005). *Investigation of effect of conceptual change approach on understanding of electrochemistry concepts* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Ekici, F. (2015). *Instruction of basic learning strategies to develop the self-regulated learning strategies of pre-service chemistry teachers* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Elmas, R. (2012). *The effect of context based instruction on 9th grade students understanding of cleaning materials topic and their attitude toward environment* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Ercan, O. (2009). Determining misconceptions of teachers on electrochemistry and the effect of teaching method on the success of pre-service teachers over electrochemistry (Unpublished doctoral dissertation). Gazi University, Ankara.

+Erdemir, A. (2006). *Effect of cooperative learning based on conceptual change conditions on seventh grade students' understanding of classification of matter and physical and chemical changes* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Erdoğan, M.N. (2011). *The effect of nature of science focused science content teaching through explicit-reflective teaching sequences on high school students' nature of science understanding* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Erokten, S. (2006). *Different evaluations related with teaching 'green chemistry' topic in chemistry education* (Unpublished doctoral dissertation). Hacettepe University, Ankara.

+Eymür, G. (2014). *The effect of cooperative learning based on conceptual change approach on students' understanding of chemical bonding concepts* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

Falkingham, L. T. & Reeves, R. (1998). Context analysis—A technique for analysing research in a field, applied to literature on the Management of R&D at the section level. *Scientometrics, 42*(2), 97-120.

+Feyzioglu, B. (2006). *A comparative application of different learning process' for teaching and removing of misconceptions in general chemistry* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

Gilbert, J. K. (2006). On the nature of "context" in chemical education. *International journal of science education, 28*(9), 957-976.

+Gültekin, C. (2014). *Comparison of abilities on drawing, reading and interpreting of graphs of the secondary education students and university students in change of state, solutions and solubility subjects* (Unpublished doctoral dissertation). Balıkesir University, Balıkesir.

+Gültepe, N. (2011). *Effect of argumentation based instruction on improvement of high school students' science process skills and critical thinking ability* (Unpublished doctoral dissertation). Gazi University, Ankara

+Gümrah, A. (2013). *The effects of scientific argumentation on secondary students' conceptual understanding of chemical changes, nature of science views, science process, communication and argument skills* (Unpublished doctoral dissertation). Marmara University, Istanbul.

Gürel, D. K., Ölmeztürk, A., Durmaz, B., Abul, E., Özün, H., Irak, M., Subaşı, Ö. & Baydar, Z. (2017). 1990-2016 yılları arasında türkiye'de fizik eğitimi alanında yayınlanmış tezlerin içerik analizi [The content analysis of the graduate theses in physics education in turkey between the years 1990 and 2016]. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi, 37*(3), 1141-1172.

+Icoz, Ö.F. (2016). *Effectiveness of context based instruction on 10th grade students' understanding of fossil fuels and clean energy resources topics and their attitudes toward environment* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Ilhan, N. (2010). *The effect of context based approach on the learning of chemical equilibrium* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Inal, A. (2013). *Determining the effects of teaching chemical bonds subject of 9th class with learning styles and traditional learning approach to a students' academic achievement* (Unpublished doctoral dissertation). Gazi University, Ankara.

Jorde, D. & Dillon, J. (Eds.). (2012). *Science education research and practice in Europe: retrospective and prospective* (Vol. 5). Springer Science & Business Media.

+Kadayıfcı, H. (2008). *The effect of an instructional model based on creative thinking on students' conceptual understanding of separation of matter subject and their scientific creativity* (Unpublished doctoral dissertation). Gazi University, Ankara

+Kadıoglu, C. (2014). *Implementation of self-regulatory instruction based on guided inquiry approach to promote students' achievement in solubility equilibrium and acids and bases, motivation, and learning strategies* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Kahraman, S. (2010). *The effect of three-dimensional computer assisted instruction materials developed for the atomic structure and orbitals on the success and attitudes of undergraduates* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Kala, N. (2012). *The effect of instructional design prepared on thermodynamics unit by using Cognitive Load Theory on chemistry students? learning at retention and transfer level* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Karaaslan, E.H. (2014). *An investigation on enhancing elementary school teachers candidates' capability of explaining chemical concepts* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Kara, H. (2018). *The effect of 5e model-based interactive notebook on students' achievement about mixture, motivation and attitude* (Unpublished doctoral dissertation). Hacettepe University, Ankara

+Karacop, A. (2010). *Effects of jigsaw and animation techniques on students? understanding of subjects in electrochemistry and chemical bonding units* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

Karadag, E. (2009). Eğitim bilimleri alanında yapılmış doktora tezlerinin tematik açıdan incelemesi [A thematic analysis on doctoral dissertations made in the area of education sciences]. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi, 10*(3), 75-87.

+Karaduman, B. (2016). *From scientific knowledge to learned knowledge: investigation of the concepts about gases through didactic transposition in higher education* (Unpublished doctoral dissertation). Çukurova University, Adana.

+Karamustafaoglu, S. (2003). *Developing guide material based on simple tools related to the unit 'travel to inner structure of matter' and it's effectiveness on teaching process* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Karslı, F. (2011). *The effect of enriched laboratory guide materials on improving science process skills and conceptual change of prospective science teachers* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Kaya, E. (2011). *The effect of conceptual change based instruction on students' understanding of rate of reaction concepts* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Kavak, N. (2004). *The effect of constructivist role-play instruction method on conceptual achievement and perception, interest and attiude of lise 2 (grade 10) about dissolution of substances* (Unpublished doctoral dissertation). Gazi University, Ankara

Kempa, R. (2002). Research and research utilisation in chemical education. *Chemistry Education Research and Practice, 3*(3), 327-343.

+Kıngır, S. (2011). *Usıng the scıence wrıtıng heurıstıc approach to promote student understandıng in chemıcal changes and mıxtures* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Kıpık, M. (2015). *Assessment of teacher competency and infrastructure problems in implementing chemistry programs* (Unpublished doctoral dissertation). Gazi University, Ankara

+Kıran, B.E. (2016). *Interaction between experienced chemistry teachers' science teaching orientations and other components of pedagogical content knowledge in mixtures*

(Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Kırbulut, Z.D. (2012*). The effect of meta conceptual teaching instruction on 10th grade students understanding of states of matter, self-efficacy toward chemistry, and the nature of meta conceptual processes* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Kırkıç, K.A. (2001). *The Effect of mastery learning method on the achievement and the retention levels of chemistry students* (Unpublished doctoral dissertation). Marmara University, Istanbul.

+Kızılaslan, A. (2016*). Teaching concepts related 'phases of matter and heat' unit to 8th grade visually impaired primary students* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Kocak, C. (2011). *Evaluation of chemistry topics within the daily life concept* (Unpublished doctoral dissertation). Hacettepe University, Ankara.

+Kolomuc, A. (2009*). Animation aidet instruction on ?rate of chemical reactions unit in grade 11 in regart to 5E model* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Konur, K.B. (2010). *The effect of conceptual change texts on the pre-service primary teachers? understanding of physical and chemical change topics* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

Kozikoglu, I., & Senemoglu, N. (2015). The Content Analysis of Dissertations Completed in the Field of Curriculum and Instruction (2009-2014). *Egitim ve Bilim, 40*(182), 29-41.

+Kurbanoglu, N.İ. (2003). *A study on programmed teaching of stereochemistry in organic chemistry* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Kurt, S. (2010). *Developing and evaluating materials related to ''rate of chemical reactions topic* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Kutu, H. (2011). *Teaching chemistry in our lives unit in the 9th grade chemistry course through context-based ARCS instructional model* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Kutucu, E.S. (2016). *Examination of interaction between pre-service chemistry teachers' pedagogical content knowledge and content knowledge in electrochemistry* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

Kucukozer, A. (2016). Fen bilgisi eğitimi alanında yapılan doktora tezlerine bir bakış [An overview of the doctoral thesis in science education]. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi, 10*(1), 107-141.

McMillan, J. H., & Schumacher, S. (2010). *Research in education: Evidence-based inquiry* (7th edt.). New York: Longman.

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. John Wiley & Sons.

+Mete, P. (2016). *Teaching the features of some matters - 'hard-soft'- through direct teaching method to intellectually disabled students in a special subclass of a middle school* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

Miles, M. B., & Huberman, A. (1994). M.(1994). *Qualitative data analysis: An expanded sourcebook.* Thousand Oaks, CA: Sage Publications.

+Mutlu, A. (2015). *The effect of guided inquiry based general chemistry activities on learning process in real and virtual environments* (Unpublished doctoral dissertation). İstanbul University, İstanbul.

+Neseriazar, A. (2015). *Effectiveness of different conceptual change techniques enhanced with 5E model in teaching chemical equilibrium* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Ogunç, A. (2012). *Development, application and evaluation of an active learning material based on constructivism related to 'reaction rates and chemical equilibrium' subject in chemistry lesson* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

+Oluk, N.T. (2016). *The comparision of different concept mapping tasks in chemistry education* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Onder, İ. (2006). *The effect of conceptual change approach on students' understanding of solubility equilibrium concept* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Oskay, Ö.Ö. (2007). *Technology assisted problem-based learning applications in chemistry education* (Unpublished doctoral dissertation). Hacettepe University, Ankara.

+Ozbayrak, Ö. (2013). *Misconceptions in chemistry education: Compounds* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

+Ozcan, O. (2017). *An action research towards teaching acids and bases to grade 12 students through peer instruction* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Ozdemir, İ.B.A.(2017). *Comparison of the effects of explicit nature of science instruction and explicit nature of science instruction integrated with explicit argumentation instruction on grade 10 students' understandings, argumentation skills and attitudes*

towards chemistry (Unpublished doctoral dissertation). Marmara University, İstanbul.

+Ozeken, Ö.F. (2011). *An investigation of effectiveness of problem based learning in teaching acid-base subject* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Ozel, U. (2018). *Development of argumentation skills of vocational high school students with scientific and socioscientific issues* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Ozgur, S.D. (2016). *The effect of inquiry based learning on gifted and talented students' understanding of acids-bases concepts and motivation towards science learning* (Unpublished doctoral dissertation). Hacettepe University, Ankara.

+Ozmen, H. (2002). *Developing and implementing guide materials for chemistry teachers for the chemical reaction unit* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Oztekin, A. (2013). Evaluation of secondary school 10th grade chemistry instructional curriculum Unpublished doctoral dissertation). Balıkesir University, Balıkesir.

+Pabuccu, A. (2008*). Improving 11th grade students' understanding of acid-base concepts by using 5E learning cycle model* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Pınarbasi, T. (2002). *Investigations of effectiveness of conceptual change approach on understanding of solubility concepts* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Sadi, S. (2013). *The effects of the context- based learning approach on the training of chemical changes unit* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Sahin, Ş. (2016). *The content analysis of the chemistry text books in terms of the acquisition related with nature of science* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Sarıbas, D. (2009). *Investigating the effect of laboratory environment aimed to improve self-regulated learning strategies on conceptual understanding, science process skills and attitude towards chemistry* (Unpublished doctoral dissertation). Marmara University, İstanbul.

+Sarıcayır, H. (2007). *The impact of computer-assisted and laboratory-based teaching methods in the teaching of chemical equilibrium on students? achievement, recall level and attitudes toward chemistry* (Unpublished doctoral dissertation). Marmara University, İstanbul.

+Sarıtas, D. (2012). *The rational knowledge, in the process of the teaching periodic system; its genaration, epistemology and methodology* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Seker, A. (2012). *Conceptual change oriented instruction and students' misconceptions in chemical bonding concepts* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Sekerci, A.R. (2013). *The effect of argumentation based instruction on students? argumentation skills and conceptual understanding in Chemistry laboratory* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Sen, A.Z. (2018). *Examination of experienced chemistry teachers' pedagogical content knowledge in the context of physical and chemical changes* (Unpublished doctoral dissertation). Balıkesir University, Balıkesir.

+Sen, Ş. (2015). *Investigation of students' conceptual understanding of electrochemistry and self-regulated learning skills in process oriented guided inquiry learning environment* (Unpublished doctoral dissertation). Hacettepe University, Ankara.

+Sendur, G. (2009). *Applying Ausubel's expository teaching to overcome misconceptions about chemical equilibrium* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

+Senocak, E. (2005). *A study on the effects of problem-based learning approach on teaching the gases* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Sevim, S. (2007). *Preparation and application of conceptual change texts on solution and chemical bonding concepts* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Sevinc, B. (2015). *Developing and evaluating the effectiveness of materials based on REACT strategy on the subject of acids and bases* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Seyhan, H.G. (2008). *Developing inquiry based student experiments in the chemistry education and discussing results* (Unpublished doctoral dissertation). Hacettepe University, Ankara.

+Simşek, P. (2013). *The effects of inquiry based learning on primary students' academic achievement and conceptual understanding of matter, attitudes towards science, science process and communication skills* (Unpublished doctoral dissertation). Marmara University, İstanbul.

+Simşek, Ü. (2007). *The effects of the Jigsaw and learning together techniques applied in solutions and chemical equilibrium subjects on learning of the particulate nature of matter by the students and their the academic achievements* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

Sozbilir, M. (2013). Chemistry education research in Turkey. *Chemistry International, 35*(2), 12-14.

Sozbilir, M., Akilli, M., Yasar, M. D., & Dede, H. (2016). Development of chemistry education research (CER) in Turkey: A comparison of CER papers with international research. *In Science Education Research and Practice in Asia* (pp. 289-317). Springer, Singapore.

Sozbilir, M., Kutu, H., & Yasar, M. D. (2012). Science education research in Turkey. *In Science Education Research and Practice in Europe* (pp. 341-374). Sense Publishers, Rotterdam.

Sozbilir, M. & Ayas, A. (2015). *Kimya ve kimya eğitiminin ülkemizde gelişimi [Development of chemistry and chemistry education in our countr*y]. Ayas, A. and Sözbilir, M. (Edt). Kimya Öğretimi içinde *[Chemistery Teaching*] (s. 1-12). İstanbul: Pegem Akademi.

Sozbilir, M., Kutu, H., & Yaşar, M. D. (2013). Türkiye'de kimya eğitimi araştırmalarının durumu ve eğilimler [The status of chemistry education researches and trends in Turkey]. M. Sözbilir (Edt.). *Türkiye'de kimya eğitimi [Chemistery Education in Turkey*], 175-204.

+Sonmez, D.Y. (2015). *The effect of case based learning instruction on 11th grade students' understanding of acids and bases concepts and their motivation to learn chemistry* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Sunar, S. (2013). *The effect of context-based instruction integrated with learning cycle model on students' achievement and retention related to states of matter subject* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

Suri, H. & Clarke, D. (2009). Advancements in research synthesis methods: From a methodologically inclusive perspective. *Review of Educational Research, 79*(1), 395-430.

+Tamer, P.İ. (2006). *Effect of conceptual change texts accompanied with analogies on promoting conceptual change in acid and base concepts* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Tarkın, A. (2014). *Implementation of case-based instruction on electrochemistry at 11th grade level* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Tasdelen, U. (2011). *The effects of computer-based interactive conceptual change texts on 11th grade students' understanding of electrochemistry concepts and attitude toward chemistry* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Tastan, Ö. (2009). *Effect of cooperative learning based on conceptual change conditions on motivation and understanding of reaction rate* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Tatar, E. (2007). *Effect of problem based learning approach on understanding of the first law of thermodynamics* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Tatlı, Z. (2011). *Development, application and evaluation of virtual chemistry laboratory experiments for chemichal changes unit at secondary school 9th grade curriculum* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon

+Tekin, S. (2004). *Development an inservice programme concerning conceptual understanding and concept teaching for chemistry teachers and investigation of its influence in practice* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Temel, S. (2009). *Problem solving applications in chemistry laboratory* (Unpublished doctoral dissertation). Hacattepe University, Ankara.

Teo, T. W., Goh, M. T. and Yeo, L. W. (2014). Chemistry education research trends: 2004–2013. *Chemistry Education Research and Practice, 15*(4), 470-487.

+Tosun, C. (2010). *The effect of problem based learning method on understanding of the solutions and its' physical properties* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

Towns M. H., (2013), New guidelines for chemistry education research manuscripts and future directions of the field, *Journal of Chemical Education. 90*, 1107–1008.

Towns M. H. & Kraft A., (2011), Review and synthesis of research in chemical education from 2000–2010. *A white paper for the National Academies National Research Council Board of Science Education*, Committee on Status, Contributions, and Future Directions of Discipline Based Education Research.

+Tunc, T. (2015). *The effect of problem based learning on students' academic achievements in the subject of electrochemistry in analytical chemistry course* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

+Turacoglu, İ. (2013). *Researching the effect of constructivist approach applied in science and technology curriculum to the students readiness levels of 9th grade chemistry course* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

+Tumay, H. (2008). *Argumentation focused chemistry teaching* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Tutuncu, G. (2016). *Development and implementation of a teaching material about high school 10th grade gases topic based on the context-based approach reinforced by stories* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Tuysuz, C. (2005). *Developing WEB based materials related to primary school science-chemistry topic and their application to science teaching* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

+Tuysuz, M. (2015). *The effect of 5E learning cycle and multiple intelligence approach on 9th grade students' achievement on unit of chemical properties, attitude, and motivation toward chemistry* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Tuzun, Ü.N. (2016). *Enhancing high school students' critical thinking skills via enhancing their argumentation skills in science education* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Ulusoy, F. (2011). *The effects of interventions based on chemical modelling and computer based teaching over 12 graders' learning outcomes: The case of chemical bonding* (Unpublished doctoral dissertation). Marmara University, İstanbul.

+Ultay, N. (2012). *Designing, implementing and comparing acids and bases instructional tasks based on REACT strategy and 5E model* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Ulutas, B. (2016). *An investigation of the change in pre-service chemistry teachers' motivation in self-regulated learning environments* (Unpublished doctoral dissertation). Gazi University, Ankara.

Ulutas, B., Üner, S., Turan Oluk, N., Yalçın Çelik, A., & Akkuş, H. (2015). Türkiye'deki kimya eğitimi makalelerinin incelenmesi: 2000-2013. *Journal of Kirsehir Education Faculty, 16*(2), 141-160.

+Unal, S. (2007). *A new approach on teaching of chemical bonds and intermolecular forces: The effects of CAI and CCT on conceptual change* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Uner, S. (2016). *Examination of the topic-specific nature of chemistry teachers' pedagogical content knowledge and students' perceptions of their teachers' pedagogical content knowledge* (Unpublished doctoral dissertation). Gazi University, Ankara.

+Unlu, Y. (2014). *Conceptual change texts oriented instruction in teaching solution concepts* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Usta, N.D. (2011). *Developing, implementing and evaluating cai materials related to "radioactivity" topic based on constructivist learning theory* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Uyulgan, M.A. (2012). *Performance evaluation of prospective chemistry teachers? subject matter knowledge* (Unpublished doctoral dissertation). Dokuz Eylül University, İzmir.

+Uzuntiryaki, E. (2003). *Effectiveness of constructivist approach on students' understanding of chemical bonding concepts* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Vural, S. (2016). *The effect of teaching material based on the common knowledge consruction model on the gifted students' understanding of concepts: 'acid-base'* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Yadigaroğlu, M. (2014). *Developing an in-service training programme for improving chemistry teachers' knowledge and skills about technological pedagogical content knowledge model and investigating its effectiveness* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Yalçın, F.A. (2010). *The preparation, implementation and evaluation of active learning activities based on constructivist approach in teaching acids and bases at high school and university level* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Yalcın, M. (2003). *The Use as a guide of continuous assessment in physical chemistry teaching: A case study* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Yalcın, M. (2012). *The reliability of different (written) measurement tools used in high school chemistry for the solution concept in evaluating students' success* (Unpublished doctoral dissertation).Gazi University, Ankara.

+Yalcınkaya, E. (2010). *Effect of case based learning on 10th grade students' understanding of gas concepts, their attitude and motivation* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Yaman, F. (2012). *The effect of computer-based predict-observe-explain (POE) tasks on students? conceptual understanding related to acid-base chemistry: Cases from Turkey and the USA* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Yasar, M.D. (2012). *An investigation of chemistry teachers? perceptions and implementation of constructivist principles in 9th grade chemistry curriculum: The case of Erzurum* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Yavuz, A. (2005). *Effectiveness of conceptual change instruction accompanied with demonstrations and computer assisted concept mapping on students' understanding of matter concepts* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

+Yavuz, S. (2006). *Evaluation of the effect of project-based learning model on chemistry education students environmental knowledge and attitudes towards environment* (Unpublished doctoral dissertation). Hacettepe University, Ankara.

Yavuz, S. (2017). Kimya eğitimi alanında kavram yanılgıları ile ilgili tamamlanmış tezler üzerine bir içerik analizi: Türkiye örneği (2005-2015). *Kastamonu Eğitim Dergisi, 25*(3), 957-974.

+Yesiloglu, S.N. (2014). *Epistemology and nature of science understandings during practical works in school science: A chemistry course case* (Unpublished doctoral dissertation). Gazi University, Ankara.

Yıldırım, A., & Simsek, H. (2013). *Sosyal bilimlerde nitel araştırma yöntemleri [Qualitative research methods in the social sciences*]. (9. Genişletilmiş Baskı) Ankara: Seçkin yayıncılık.

+Yıldırım, N. (2009). *Developing, implementing and evaluating materials related to ''chemical equilibrium" topic* (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon.

+Yıldırım, T. (2017). *The survey on the effectiveness of peer instruction method in teaching solutions at high school level* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+Yıldırır, H.E. (2013). *The evaluation of learning environment based argumentation in classroom: A case study involving experienced chemistry teachers and prospective chemistry teachers* (Unpublished doctoral dissertation). Balıkesir University, Balıkesir.

+Yoruk, N.Z. (2010). *Effects of Science, Technoogy, Society and Environment (STSE) approach teaching chemistry with using the 5E learning model* (Unpublished doctoral dissertation). Hacettepe University, Ankara.

+Zorluoglu, S.L. (2017). *Teaching the concepts in particulate nature of matter to 6th grade visually impaired students level* (Unpublished doctoral dissertation). Ataturk University, Erzurum.

+ Doctoral thesis examined.

Türkiye Kimya Eğitimi Doktora Tezlerinde Eğilimler

Atıf:

Yıldırım, T. (2020). Trends in PhD theses in Turkish chemistry education (1999-2019). *Eurasian Journal of Educational Research 89, 201-240,* DOI: 10.14689/ejer.2020.89.10

Özet

Problem Durumu: YÖK (Yüksek Öğretim Kurulu)/Dünya Bankası Milli Eğitimi Geliştirme projesi kapsamında 1998 yılında eğitim fakülteleri yeniden yapılandırılmış ve işlevlerinde köklü değişikliklere gidilmiştir. Bu tarihten sonra Türkiye'de kimya eğitim araştırmalarında önemli artış gözlenmiştir. Eğitim fakültelerinde görev yapan akademisyenlerin eğitim bilimleri, öğretmen eğitimi ve alan eğitimi gibi alanlara

yönlenmesi ile kimya eğitim alanı gelişmiş ve 2000'li yıllarda büyük bir ivme yakalayarak 2000'li yılların ortalarında zirve yapmıştır. Artan yayın sayısı ile birlikte kimya eğitim alanında farklı niteliklerde çalışmalar ortaya konmuştur. Her hangi bir konu üstüne çalışan araştırmacılar o konu ile ilgili yapılan araştırmalara ulaşırken zorluk çekmekte ve fazla sayıda olan çalışmalara ulaşmak için zaman kaybetmektedirler. Alanda ne tür araştırmalara ihtiyaç olduğunu belirleyerek gelecek çalışmalara yön verecek araştırmaların önemi artmaktadır. Bundan dolayı kimya eğitim alanında yapılan çalışmaların ve bu çalışmalardan elde edilen sonuçların yakından takip edilerek alandaki eğilimlerin belirlenmesi bu alanda çalışma yapan bilim insanlarına yol gösterici nitelikte olacaktır. Doktora tezleri, ilgili alanın bilimsel bir disiplin olarak gelişmesine katkıları olan, diğer araştırmalara göre daha kapsamlı, uzun süreli ve özgün olmaları nedeniyle önemli çalışmalardır. Doktora tezlerinden bilime yenilik getirmeleri beklenmektedir. Doktora tezleri, alan eğitiminde araştırma konularının ve yöntemlerinin yaygınlığını görmek, zamanla eğilimin nasıl değiştiğini ve güncel durumun genel görünümü hakkında bilgi vermek açısından önemli bir veri kaynağıdır.

Araştırmanın Amacı: Türkiye'de eğitim fakültelerinin yeniden yapılanmasından sonra son yirmi yıl içinde (1999-2019) kimya eğitimi alanında gerçekleştirilen doktora tezlerini içerik analizi yapmaktır. Kimya eğitim alanında Türkiye'de tamamlanan doktora tezleri; konusu, yöntemi, hangi üniversitelerde yapıldığı, yıllara göre dağılımı, kullanılan öğretim yaklaşımı, hangi kimya konularının çalışıldığı, örneklemi, kullanılan veri toplama araçları ve veri analiz yöntemleri açısından incelenmiştir.

Araştırmanın Yöntemi: Bu araştırma, nitel araştırma yaklaşımlarından doküman inceleme kullanılarak gerçekleştirilmiştir. Bu araştırmada incelenen dokümanlar Türkiye'de 1999-2019 yılları arasında kimya eğitimi alanında yapılan doktora tezleridir. Elde edilen tezler betimsel içerik analizine tabi tutulmuştur. YÖK tez veri tabanı kullanılarak kapsamlı bir tarama yapılmış ve 168 doktora tezi araştırmaya dahil edilmiştir. Elde edilen tezlerin analizi Sözbilir, Kutu ve Yaşar (2012) tarafından geliştirilen "Yayın Sınıflama Formu (YSF)" ile yapılmıştır. Tezlerin içerik analizinin güvenilirliğini sağlamak için incelenen 168 doktora tezi araştırmacı tarafından bir ay arayla iki kez sınıflandırılmıştır. İki inceleme arasındaki uyum %94 düzeyinde çıkmıştır.

Araştırmanın Bulguları: 1999-2019 yılları arasında kimya eğitimi alanında ilk doktora tezleri 2001-2002 yıllarında tamamlanmaya başlayıp giderek artmış 2012 yılında yapılan tez sayısı en yüksek seviyeye ulaşmıştır. Daha sonraki yıllarda yapılan tez sayısında düşüş görülmüştür. Yapılan tezlerin üniversitelere göre dağılımında en çok tezin (%23) Orta Doğu Teknik Üniversitesinde (ODTÜ) yapıldığı görülür. Sonra sırası ile Atatürk Üniversitesi (%20), Gazi Üniversitesi (%16), Karadeniz Teknik Üniversitesi (%14), Dokuz Eylül Üniversitesi (%8), Marmara Üniversitesi (%8), Hacettepe Üniversitesi (%7), ve Balıkesir Üniversitesi (%2) gelmektedir. Yapılan tezlerin konu dağılımında öğretme ve öğrenmeyi artırma üzerine yapıldığı, çalışmaların büyük bir kısmı uygulanan öğretim yöntemlerinin öğrencilerin başarılarına etkisi üzerinde yoğunlaştığı (%82) görülür. Bunun yanında azda olsa öğretmenlik mesleği (%5), müfredat çalışması (%3), öğretmen eğitimi (%3) gibi farklı konular üzerine çalışmalar

da bulunmaktadır. En sık uygulanan öğretim yöntemleri 5E öğrenme modeli (18) ve kavramsal değişim yaklaşımı (18) olmuştur. Tez çalışmaları sırasında yapılan uygulamaların hangi kimya konusu üzerinde olduğuna bakıldığında; en çok çalışılan kimya konusu asitler-Bazlar (16) olmuştur. Maddenin yapısı (13), farklı genel kimya konularının harmanlandığı çalışmalar (13), kimyasal denge (11), çözeltiler konusu (10), elektrokimya konusu (9), kimyasal bağlar (9), gazlar (8), reaksiyon hızı (7), Kimya deneyleri (7) üzerine yapılan tezler, fiziksel ve kimyasal değişmeler (6), çevre kimyası (5) konuları sıklıkla tercih edilen kimya konuları olmuştur. En çok kullanılan araştırma yöntemlerinin nicel yöntemler (%62) olduğu, nitel (%21) ve karma yöntemlerin (%17) daha az kullanıldığı görülmektedir. Yarı deneysel desenin (%53) bariz bir şekilde en çok kullanıldığı, daha sonra nitel durum çalışmasının (%18) tercih edildiği ve karma desenlerden de çeşitleme desen (%9) ile araştırmaların sıklıkla yürütüldüğü görülmüştür. Araştırmacıların en çok tercih ettikleri örneklem grubu lise (%49) düzeyi olmuştur. İkinci olarak önemli oranda üniversite (%35) düzeyi örneklem grubu sıklıkla çalışılmıştır. En sık çalışılan örneklem büyüklüğü 31-100 (83) arası grup olmuştur. Bunu 101-300 arası (46), 11-30 arası (21) gruplar takip etmektedir. İçerik analizi yapılan 162 tezde toplam 635 veri toplama aracı kullanıldığı tespit edilmiştir. En çok kullanılan veri toplama aracı mülakat (%17,8) olmuştur. Derse yönelik tutum ölçeği (%12,8), gözlem (%10,4) ve ders başarısını ölçmek için kullanılan kavram testi (%11) ile başarı testi (%10,4) sık kullanılan ölçekler olmuştur. Çalışmalarda en çok 3 çeşit veri analiz yöntemi (%43) tercih edilmiştir. İkinci olarak 2 çeşit veri analiz yöntemi (%27), üçüncü olarak ise 4 ve üzeri veri analiz yöntemi (%19) kullanılmıştır. Araştırma kapsamında incelenen doktora tezlerinde sıklıkla kullanılan veri analiz yöntemleri açısından en çok kestirimsel (%51) istatistikten yararlanılmıştır. Nitel veri analiz yöntemlerinden %25, betimsel istatistikten ise %21 oranında faydalanılmıştır. Kestirimsel istatistikî yöntemlerden en çok t testi (72) kullanılmış hemen sonra anova/ancova (70) yöntemi tercih edilmiştir. Mann-Whitney U/Wilcoxon işaretler Testi (33) ve manova\mancova (31) da sıklıkla kullanılan kestirimsel istatistiki yöntemler arasındadır.

Araştırmanın Sonuçları ve Önerileri: Araştırma sonuçları bütün olarak değerlendirildiğinde araştırma yöntemlerinin tezlerde yeterince uygun bir biçimde tanımlanamadığı görülmüştür. Bundan dolayı lisansüstü derslerde araştırma yöntemleri derslerine daha fazla ağırlık verilerek uygulamalı örnek dersler yapılması tavsiye edilebilir. Uluslararası trende uygun şekilde karma yöntem araştırmalara daha çok önem verilmesi ve eğitim ortamlarını doğal biçimde değerlendiren nitel çalışmaların artırılması gerekmektedir. Tez yürütücülerin kolay ulaşılabilir örnekleme yöneldiği görülmüştür. Farklı örnekleme yöntemleri ile çalışmaların yapılması yerinde olacaktır. Veri toplama araçları ve analiz yöntem sayısı olarak tezlerin geçerlilik ve güvenilirlik açısından yeterli olduğu söylenebilir. Ancak nitel bulguların sıklıkla frekans-yüzde şeklinde nicelleştirildiği görülmüştür. Nitel verilerin daha farklı analizine yoğunlaşılmasına ve verilerin birbiri ile entegre edilmesine daha çok özen gösterilmelidir.

Anahtar Sözcükler: Kimya eğitimi, içerik analizi, doktora tezi, eğilim

Appendix 1. *Thesis Classification Form*

Information about Thesis	
Title:	
Author:	**Adviser:**
Date:	**University:**
Subject of The Thesis	
1. ◯ Instruction	5. ◯ Teacher education
2. ◯ Learning	6. ◯ Material development
3. ◯ Teaching as a profession	7. ◯ Determining attitude/interest/motivation
4. ◯ Curricula work	8. ◯ Other ……..
Applied Instruction Approaches	
1. ◯ 5E Learning model	7. ◯ Cooperative learning
2. ◯ Conceptual change approach	8. ◯ Problem-based learning
3. ◯ Argumentation-based instruction	9. ◯ Computer-assisted instruction
4. ◯ Context (life) based learning	10. ◯ Inquiry-based learning
5. ◯ Active learning methods	11. ◯ Project-based learning
6. ◯ Concept maps	12. ◯ Other ……
Chemistry Subject	
1. ◯ Acids-Alkalis	7. ◯ The Structure of Matter
2. ◯ Chemical Balance	8. ◯ Reaction Rate
3. ◯ Solutions	9. ◯ Thermodynamics
4. ◯ Chemical Bonds	10. ◯ Atoms and the Periodic System
5. ◯ Electrochemistry	11. ◯ Environmental Chemistry
6. ◯ Gases	12. ◯ Other ……
Research Methods/Designs	
1. ◯ True-experimental	7. ◯ Case study
2. ◯ Quasi-experimental	8. ◯ Action research
3. ◯ Weak experimental	9. ◯ Explanatory mixed design
4. ◯ Document review	10. ◯ Exploratory mixed design
5. ◯ Descriptive survey	11. ◯ Triangulation mixed design
6. ◯ Relational survey	12. ◯ Embedded design
	13. ◯ Other ……..
Data Collection Tool	
1. ◯ Concept Testing	7. ◯ Questionnaire
2. ◯ Achievement Test	8. ◯ Scientific Attitude Test
3. ◯ Course-Based Attitude Scale	9. ◯ Logical Reasoning Test
4. ◯ Method-based Attitude Scale	10. ◯ Written Reflections
5. ◯ Interview	11. ◯ Attitude Scale on Nature of Science
6. ◯ Observation	12. ◯ Other ……
Sample	**Sample Size**
1. ◯ Middle School	1. ◯ Between 1-10
2. ◯ High School	2. ◯ Between 11-30
3. ◯ University	3. ◯ Between 31-100
4. ◯ Teacher	4. ◯ Between 101-300
5. ◯ Other ……	5. ◯ Above 300
Data Analysis	
1. ◯ frequency and percentage tables	6. ◯ Correlation
2. ◯ t-tests	7. ◯ Regression
3. ◯ ANOVA/ANCOVA	8. ◯ Content analysis
4. ◯ Mann-Whitney U/Wilcoxon Signed-Rank Test	9. ◯ Descriptive analysis
	10. ◯ Others ……
5. ◯ MANOVA/MANCOVA	