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Research Article

Analysis of the Experiments in the Chemistry Textbooks in terms of the Laboratory Study Goal of the 2018 Chemistry Curriculum and Comparison with the Case of Science High School

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Abstract – This study aims to examine to what extent the goal of the 2018 Chemistry Curriculum for experimental studies overlaps with the acquisitions of the curriculum and to what extent upper-secondary school chemistry textbooks (high school) are prepared to meet this purpose. The study also seeks to assess the extent to which the activities in the chemistry textbooks are written to meet the four dimensions (gaining data by experimenting, inferring using data, interpretation, and generalization) of the 2018 Chemistry Curriculum. Finally, it is intended to compare this situation with the 2018 Science High School Chemistry Curriculum and determine the similarities and differences. For these purposes, the acquisitions including the experimental studies in the 2018 Chemistry Curriculum were determined at first. Then, the experiments in the 9^{th}, 10^{th}, $11^{th,}$ and 12^{th} grade chemistry textbooks were analyzed. Two ways were used for textbook analysis. In the first stage, it was defined to what extent the acquisitions in the 2018 Chemistry Curriculum and the experiments in the textbooks overlapped and how the experiments were distributed according to the units. In the second stage, the experiments in the textbooks were analyzed according to the four dimensions of the 2018 Chemistry Curriculum using a rubric. It was concluded that the acquisitions that include explanations about experimental studies are approximately 16% of the total acquisitions of the 2018 Chemistry Curriculum. Additionally, as a result of this analysis for SPSs, it is found that the experiments mostly focus on the basic SSBs, and they focus especially on "observation" and "measurement" skills.

Keywords: 2018 Chemistry Curriculum, upper-secondary school chemistry textbook, experimental study.

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Introduction

It is essential to provide teaching experience that will enable students to better understand science subjects so that countries do not fall behind in scientific and technological developments, and to raise individuals who can produce knowledge and technology (Ayas, 1995; Zorluoğlu et al., 2016). For this reason, the approaches used in the development of secondary education chemistry curricula are very important. In recent years, it is seen that scientific process skills, research and inquiry-based activities, and acquisitions that will improve students' scientific literacy are included in the curricula developed both in the world and in Turkey (Ministry of National Education (MoNE), 2018a). Mattheis and Nakayama (1988) emphasized that the most important goals of science education are the development of laboratory skills and scientific process skills necessary for the process and applications of science, and the understanding of scientific information that is the product of these, and they argued that laboratory work has an important role in achieving these goals. Besides conducting laboratory studies within the scope of upper-secondary school chemistry courses is crucial and provides students with the opportunity to conduct experiments and understand the nature of research (Nakiboğlu & Şen, 2020). In addition, laboratory studies contribute to students in different dimensions such as problem-solving and scientific process skills, understanding the nature of science, and increasing scientific knowledge. While doing experiments, students can establish the relationship between their experiment and the scientific knowledge behind the experiment (Uzezi & Zainab, 2017).

Besides, the laboratory studies during chemistry lessons and interpretation of findings and inferences during trials can contribute to the students' meaningful learning of chemistry concepts and subjects. So, Ayas (1995) stated that the basic philosophy of using laboratories in teaching is to try and observe the relationships between phenomena and/or concepts and to make inferences based on them. Developing only psychomotor skills during experimentation in a laboratory environment is not sufficient to achieve the goals expected from laboratory studies, and it is extremely important that students are designed to develop high-level thinking skills in order to achieve the desired efficiency from experimental studies. Thus, laboratory studies are included among the general objectives and acquisitions of upper-secondary chemistry education programs.

Demir and Nakiboğlu (2021) stated that curricula predict the knowledge, skills, and behaviors that individuals should have in the short and long term, and thus form a roadmap for gaining these knowledge, skills, and behaviors. Depending on this roadmap, chemistry

teachers try to bring students to the achievements of the program by conducting their lessons. At this point, it is very important to analyze the program acquisitions by considering some criteria. For this purpose, it is seen that chemistry education researchers have been examining chemistry curricula according to different criteria for many years (Aydın, 2013; Aydın et al., 2019; Ayyıldız et al., 2019; Demir et al., 2013; Nakiboğlu, 2021; Tüzün et al., 2019; Yaralı, 2022; Zorluoğlu et al., 2016). Ayyıldız et al. (2019) analyzed the acquisitions in the 2018 Chemistry Curriculum according to the Original and Revised Bloom Taxonomies. They determined that while the number of gains in the curriculum is quite high in the cognitive domain, the number of gains in the analysis, application, and knowledge level is low. It has been found that the number of gains in the synthesis and evaluation step is quite low. According to the cognitive process dimensions of the acquisitions, it was found that the acquisitions were mostly at the stage of understanding and analyzing, but there were very few gains at the stage of applying, remembering, and evaluating. In addition, it was found that there was very little gain in the creating step. Zorluoğlu et al. (2016) have also reached similar findings as a result of the analysis and evaluation of the 2013 Chemistry Curriculum acquisitions according to the structured Bloom taxonomy, and they have determined that was not acquisition for the creation step. Tüzün et al. (2019) examined the goals of the 2018 Chemistry Curriculum based on Toulmin argument pattern components and they used five argument pattern components as evaluating criteria. They found that each of the acquisitions of the high school chemistry teaching program consisted of at least one of Toulmin's argument pattern components and the construction of the acquisitions as arguments was average. Yaralı (2022) analyzed and compared the 2013 and 2018 secondary education chemistry course curricula in terms of the essential elements of the program which are “general objectives”, “units”, “recommended topic titles”, “numbers of learning outcomes”, “course hours”, “learning-teaching processes”, and “measurement and evaluation” sections.

It is seen that 13 general goals are included in the part related to the implementation of the 2018 Chemistry Curriculum. When these goals are examined, it is seen that the 9th item is as follows: "It is aimed for students to obtain data by experimenting, to make inferences using these data, to interpret them and to reach generalizations" (MoNE, 2018a). This shows that the 2018 Chemistry Curriculum has a program philosophy that constructs the knowledge rather than taking the knowledge readily, by making inferences through experimental studies, interpreting the data, and accessing theoretical knowledge in this way. In addition, when the questions in the PISA exam, which is one of the international exams, are examined, it is seen

that an important part of the questions here are those that need to be inferred using scientific data, and answers should be produced accordingly (OECD, 2019).

Demir (2021) stated that the 2018 Secondary School Chemistry Curriculum and the 2018 Secondary Science High School Chemistry Curriculum were prepared in the same direction and that creating a solid chemistry infrastructure is dominant in both programs. She also drew attention to the fact that one of the main differences between the two programs is that more experimental applications are included in the Science High School Chemistry Curriculum compared to the Chemistry Curriculum. Of course, it is extremely important to have experimental studies in terms of the establishment purposes of science high schools. On the other hand, this difference should not be too much since experimental studies have an essential role in students' acquiring some 21st century skills. At the same time, as explained above, students are required to participate in experimental studies in order to achieve the philosophy and general objectives of the 2018 Chemistry Curriculum.

It is clear that the acquisitions of the curriculum must overlap with this goal and the philosophy of the Chemistry Curriculum, and accordingly, secondary school chemistry textbooks prepared in line with the acquisitions of the curriculum must be written in the same direction. When the secondary school chemistry textbooks are examined, it is seen that in order to get the approval of the Board of Education, the acquisitions of the chemistry curriculum are taken into account, and if an expression such as "experiment is done" is included in the acquisition, an experiment for the relevant acquisition is added to the textbooks. However, it is not known whether the general goals of the programs are taken into account too much. In particular, the explanations above are clear about how guiding the textbooks are for teachers. For this reason, chemistry teachers will take textbooks as a guide when they want to apply experiments in their classes. In this case, the other important point, as well as the inclusion of an experiment suitable for the learning outcome in the textbooks, is the overlap between the goals of the curriculum regarding laboratory studies and the experiments included in the textbooks.

With this in mind, firstly this study is aimed to examine to what extent the goal of the 2018 Chemistry Curriculum for experimental studies overlaps with the acquisitions of the curriculum and to what extent secondary school chemistry textbooks are prepared to meet this purpose. Secondly, it is also intended to compare this situation with the 2018 Secondary Science High School Chemistry Curriculum and determine the similarities and differences. The research problems that guide the study in line with these two aims are as follow.

1. What are the acquisitions concerning experimental studies in the 2018 Chemistry Curriculum and their distribution according to grades? Are there similarities and differences between the distribution of the 2018 Chemistry and the Science High School Chemistry Curricula?

2. What is the distribution of the experiments in the chemistry textbooks according to units and grades? Are there similarities and differences between the distribution of the chemistry textbooks and the science high school chemistry textbooks according to the units and grade levels of the experiments?

3. To what extent do the experiments in the chemistry textbooks meet the dimensions of 'gaining data by experimenting', 'inferring from the data, 'interpreting', and 'generalizing' in the 2018 Chemistry Curriculum's goal?

Method

The study's research design, participants, and the path followed in data collection and analysis are explained below.

Research Design

The study was designed according to the document analysis method. Bowen (2009) stated that document analysis is a systematic procedure for reviewing or evaluating printed and electronic materials. In addition, He pointed out that as with other analytical methods in qualitative research, document analysis requires the examination and interpretation of data in order to reveal meaning, gain understanding, and develop empirical knowledge.

Documents

In the study, the 2018 Chemistry Curriculum and the 9^{th}, 10^{th}, $11^{th,}$ and 12^{th} grade chemistry textbooks of the MoNE, written in line with this program and approved by the Board of Education, are the primary sources used for document analysis.

In the study, sampling was carried out according to criterion sampling, which is one of the purposive sampling methods. Criteria sampling of units handle the specified criteria (Büyüköztürk et al., 2008) and the criterion can be developed by the researcher (Yıldırım & Şimşek, 2018). Since a comparison will be made between grade levels, it was taken as a criterion for the selection of books written by the same publishing house, and therefore, 9^{th}, 10^{th}, $11^{th,}$ and 12^{th} grade chemistry textbooks published by the MoNE were included in the

analysis. The list of analyzed books is given in Appendix 1 under the title of the book in the study.

Data Analysis

Altheide (1996), stated that the two interrelated principles that guide the document analysis process are impartiality and reliability, and the document analysis process is listed as follows: Determining the criteria to be included in the documents, collecting documents and data, determining the main analysis areas, coding, validating and analyzing the document (cited in Kıral, 2020). Two different analyzes were carried out in the study. The first of these is the analysis of the 2018 Chemistry Curriculum and the second is the analysis of secondary school chemistry textbooks. Separate paths were followed for both analyses and the results were compared to answer the research questions. The paths followed in both analyses are briefly explained below.

The path followed in the analysis of the program

First of all, the 2018 Chemistry Curriculum was analyzed for the acquisitions and explanations of the program in order to determine the number of acquisitions related to laboratory / experimental studies and their distribution according to grades. For this purpose, the analysis was carried out by accepting the acquisitions and explanations in the program as an acquisition related to laboratory/experimental studies, depending on the fact that they contain a statement about conducting experiments. In this way, after the analysis for each grade level, the findings were presented in tables according to the total number of acquisitions in the chemistry curriculum and the distribution of the laboratory acquisitions by grade level. Finally, the findings were compared with the analysis findings for the 2018 Science High School Chemistry Curriculum acquisitions.

The path followed in the analysis of textbooks

Textbook analyzes were carried out in two stages. In the first stage, the distribution and objectives of the experiments in the textbooks of each grade level were determined, and then each experiment was associated with acquisitions of the 2018 Chemistry Curriculum and tabulated separately for each grade level. Afterward, each grade level finding was compared with the findings obtained from science high school textbooks.

In the second stage of the textbook analysis, the analysis was carried out according to the statement "*Getting data by doing experiments, making inferences using these data, interpreting them and reaching generalizations*" in the 9th item of the 2018 Chemistry

Curriculum's aims. During this analysis, the trial and the rubric developed by Nakiboğlu (2021) were used. Explanations on this matter can be found in the related article (Nakiboğlu, 2021), and the rubric used is shown in Table 1.

Tablo 1. The rubric of Dimension Analysis

Dimensions in the 9th item of the program aim	Dimension analysis criterion
Obtaining data by experimenting	Basic BSB: observation, measurement, classification, data recording, number-space relationship, communication. Experiment validation BSB: prediction, variable identification, operational identification
Making inferences using data	Finding a result using raw data.
Interpretation	Reaching new relationships by combining the found result with theoretical knowledge.
Generalization	Making generalizations using the relationships reached.

Validity and reliability

To obtain intra-coder reliability, the author made all analyzes twice at different times and the differences were corrected. In addition, the chemistry curriculum analysis was repeated after the textbook analysis, and the related acquisitions were analyzed for the third time and it was determined that the results were completely compatible. Finally, encoder reliability was provided by making textbook analyses both in electronic format of textbooks and on printed textbooks (Gay & Airasion, 2000, s.175).

Findings

The findings obtained from the study are given below to answer the research questions.

Findings Regarding the First Research Question

In the first research question, the answer to the number of acquisitions of the 2018 Chemistry Curriculum for experimental studies and their distribution according to grades was sought. Findings related to this are presented in Table 2.

Table 2. The Total Number of Acquisitions of the 2018 Chemistry Curriculum and the Distribution of Experiment-related Acquisitions by Grade Levels

Grade level	Total number of acquisitions	Number of acquisitions related to the experimental study	%
9th grade	38	2	5,3
10th grade	23	8	34,8
11th grade	35	3	8,6
12th grade	31	4	12,9
Total	107	17	15,9

When Table 2 is examined, it is seen that the total number of acquisitions in the 2018 Chemistry Curriculum is 107 and 17 of these acquisitions, 15.9% of all program acquisitions, are related to experimental studies. When the percentages of acquisitions that include experimental studies at the grade level are examined, it is seen that 5.3% of the acquisitions in the 9th grade and 34.8% of the acquisitions in the 10th grade are related to experimental studies. It is understood that 40.1% and 28.1% of 11th and 12th grade acquisitions, respectively, are acquisitions involving experimental studies. The findings for comparing the experimental study-related acquisition percentages in the 2018 Chemistry Curriculum with the experimental study-related acquisition percentages in the 2018 Science High School Chemistry Curriculum are presented in Figure 1.

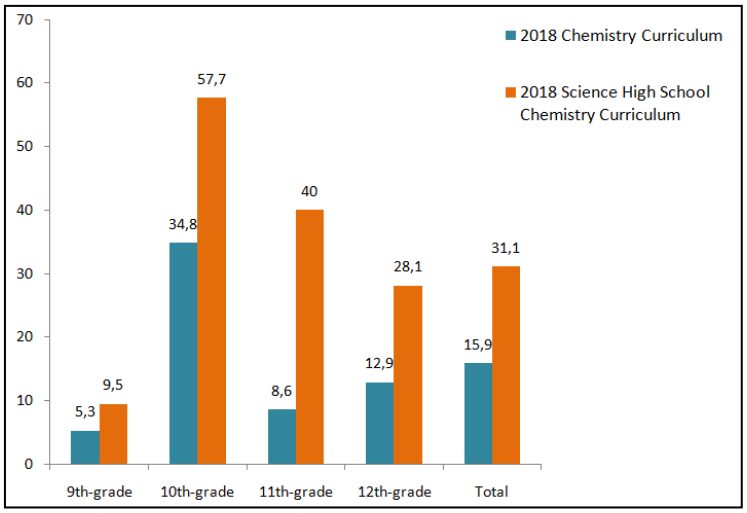

Figure 1. Comparison of the experimental study-related acquisition percentages in the 2018 Chemistry Curricula

When the two curricula are compared, it is seen that 5.3% of the achievements in the 2018 Chemistry Curriculum for 9th grade are related to experimental studies, while 9.5% of

them are related to science high school. As can be seen from Figure 1, for both curricula, the least experimental work acquisition is in the 9th grade, while the most experimental work acquisition is in the 10th grade.

Findings Regarding the Second Research Question

In the second research question, it was investigated how the experiments in the 9th, 10th, 11th, and 12th grade chemistry textbooks were distributed according to the units and grade levels. The results of the analysis of the textbooks made for this purpose are presented in separate tables for each grade level (Tables 3, 4, 5, and 6). After the presentation of tables for each grade level, the findings were compared with the findings of the 2018 Science High School Chemistry Curriculum. The distribution of the experiments in the 9th grade chemistry textbook by units and findings of the related acquisitions are shown in Table 3.

Tablo 3. The Distribution of the Experiments in the 9th grade Chemistry Textbook by Units and Findings of the Related Acquisitions

Experiment No	Unit	Title of Experiment	Associated Acquisition
1	States of matter	Effect of temperature on viscosity	9.4.3.2. To explains the factors affecting viscosity in liquid. c. *Viscosity experiments of water, glycerin, and olive oil at different temperatures are carried out and the results obtained are compared.*
2		The phase change of pure water	9.4.4.3. To interprets the state change graphs of pure substances. *c. The state change experiment of pure water is done and the graph is drawn.*

The grade 9 chemistry textbook contains five units. When Table 3 is examined, there are 2 experiments in total in the 9th grade chemistry textbook, and these experiments are placed in the 4th unit, "States of matter". It is seen that there are no experiments in the units of “Chemistry science”, “Atomic and periodic system”, “Chemical interactions between species” and “Nature and chemistry” in the 9th grade chemistry textbook. Looking at the related acquisitions of these experiments in the Chemistry Curriculum from Table 3, it is seen that there are only 2 acquisitions related to the experimental studies for the “States of matter" unit.

When these findings are compared with the achievements of the 9th grade Science High School Chemistry Curriculum and the experiments in the textbook, it is seen that while there are four outcomes for science high school, there are five experiments in the textbook. The common acquisitions and experiments are the same for the two programs and acquisitions, and it has been determined that there are three extra experiments in the 9th grade

science high school textbook. The distribution of the experiments in the 10th grade chemistry textbook by units and findings of the related acquisitions are shown in Table 4.

Table 4. The Distribution of the Experiments in the 10th grade Chemistry Textbook by Units and Findings of the Related Acquisitions

No	Unit	Title of experiment	Associated acquisition
1	Fundamental laws of chemistry and chemical calculations	Preparing of iron (II) sulfide	10.1.1.1. To explain the fundamental laws of chemistry. *b. The experiment concerning obtaining the iron(II) sulfide compound is done.*
2		Precipitation of lead (II) iodide	10.1.3.1. To explain chemical reactions. *c. The experiment concerning the precipitation of lead(II) iodide is done.*
3	Mixtures	Dissolution of different substances in water	10.2.1.2. To explain the dissolution process at the molecular level. c. *The experiments concerning the dissolution of different substances (sodium chloride, ethyl alcohol, carbon tetrachloride) in water are done.*
4		Separation of the iron powder-sulfur powder mixture	10.2.2.1. To explain mixture separation techniques used in industry and health fields.
5		Separation by melting point difference	b. *Experiments to separate the mixtures are done.*
6		Separation using the particle size difference	
7		Separation using the boiling point difference	
8		Separation using the solubility difference	
9		Separation using the solubility difference	
10		Separation by density difference	
11	Acids, Bases, and Salts	Effect of acids and bases on colored substances	10.3.1.1. To distinguish acids and bases with the help of their known properties. *c. Indicator concept and pH paper are introduced by doing experiments that acids and bases change the color of some colored substances (tea, grape juice, red cabbage).*
12		Using pH paper	*ç. The acidity or alkalinity values of vinegar, lemon juice, bleach, sodium hydroxide, hydrochloric acid, and sodium chloride solutions are interpreted using pH paper.*
13		Salt formation	10.3.2.1. To explain the reactions between acids and bases. *b. The concepts of acid, base, and salt are related by doing an experiment for the formation of sodium sulfate from the interaction of sodium hydroxide and sulfuric acid.*
14		Amphoteric property of aluminum metal	10.3.2.2. To explain the important reactions of acids and bases in terms of daily life. *b. An experiment is done showing the amphoteric property of the aluminum metal.*
15		Effect of lime and caustic on oil, hair, and skin	10.3.3.1. To explain the benefits and harms of acids and bases. *b. The effect of lime and caustic on oil, hair and skin is explained by experimentation.*

10th grade chemistry textbook contains four units. From Table 4, it is seen that there are eight acquisitions in the three units of the 2018 Chemistry Curriculum and 15 experiments related to these acquisitions in the 10th grade textbook. Experiments are located in the other three units except for the last unit, “Chemistry is everywhere”. In the first unit, 'Fundamental laws of chemistry and chemical calculations', there are two acquisitions and two experiments related to these acquisitions. The second unit is the 'Mixtures' unit and there are two acquisitions and eight experiments related to these acquisitions. The number of experiments in the third unit, ‘Acids, bases, and salts’, is five and the number of related acquisitions is four.

When the findings in Table 4 are compared with the number of experiments and related acquisitions in the 10th grade science high school chemistry textbook, there are 15 acquisitions and 22 experiments related to these acquisitions in 10th grade science high school. While there are experiments for three units in chemistry textbooks, it is seen that there are experiments for all units, namely four units, in the science high school chemistry textbook. The distribution of the experiments in the 11th grade chemistry textbook by units and findings of the related acquisitions are shown in Table 5.

Table 5. The Distribution of the Experiments in the 11th grade Chemistry Textbook by Units and Findings of the Related Acquisitions

No	Unit	Title of experiment	Associated acquisition
1	Gases	Diffusion of gases	11.2.3.1. To explain gas behavior via kinetic theory. *c. Diffusion experiment is done; …*
2	Liquid Solutions and Solubility	Comparison of boiling points of pure water and solutions of different concentrations	11.3.3.1. To establishes a relationship between the colligative properties of solutions and their concentrations. *c. Boiling point determination experiments of pure water and aqueous solutions of different concentrations are done.*
13	Equilibrium in Chemical Reactions	Strong Acid-base titration	11.6.3.8. To determines strong acid/base concentrations by titration method. *a. A titration experiment is performed and the results are interpreted by showing them graphically.*

The 11th grade textbook consists of six units, and as can be seen from Table 5, there are three experiments for only three units in the chemistry textbook. The units in which the experiments take place are units of "Gases", "Liquid solutions and solubility" and "Equilibrium in chemical reactions". It is seen that the total number of acquisitions related to the experiments in the chemistry textbook is three. It has been determined that there is no experiment in the first unit, “Modern atomic theory”, in the 4th unit, in the "Energy in chemical reactions" unit, and in the 5th unit, in the "Rate in chemical reactions" unit. When the findings of Table 5 are compared with those of the science high school, there are 14

acquisitions in the 2018 Science High School Curriculum for the 11th grade and 17 experiments related to these acquisitions in the science high school chemistry textbook. The distribution of the experiments in the 12th grade chemistry textbook by units and findings of the related acquisitions are shown in Table 6.

Table 6. The Distribution of the Experiments in the 12th grade Chemistry Textbook by Units and Findings of the Related Acquisitions

No	Unit	Title of experiment	Associated acquisition
1	Chemistry and Electricity	Electrochemical battery experiment	12.1.2.1. To explain the concepts of the electrode and electrochemical cell. *d. Zn/Cu electrochemical cell experiment is done;.....*
2		Copper plating by electrolysis method	12.1.5.1. To explain electrolysis in terms of electric current, time, and mass of matter undergoing change. *d. Plating experiment is done.*
3		Electrolysis of water	12.1.5.2. To explain the process of obtaining chemical substances by electrolysis method. *The experiment of hydrogen and oxygen production via electrolysis of water is done.*
4	Organic Compounds	To make the soap	12.3.7.1. To explain the names, formulas, and usage areas of esters. *d. The experiment of soap making is done.*

There are four units in total in the 12th grade. As can be seen from Table 6, a total of four experiments were included in only two units. It is seen that there are three experiments in the first unit, 'Chemistry and electricity', and there are three achievements related to these experiments. One experiment is included in the textbook for one achievement in the 3rd unit, 'Organic compounds'. It was determined that in the second unit, 'Introduction to carbon chemistry' and the last unit, 'Energy resources and scientific developments', there was no experiment in the 12th grade upper-secondary school textbook and related achievements involving any experiment in the 2018 Chemistry Curriculum. When these findings are compared with those of the science high school, it is seen that there are four units in the 12th grade science high school textbook and a total of 10 experiments in three of these units. In the first unit, 'Chemistry and electricity', there are six experiments and six achievements associated with these experiments. In the second unit, "Introduction to carbon chemistry", there are two experiments corresponding to a single outcome. Two experiments are included in the 12th grade science textbook for two achievements in the 3rd unit, 'Organic compounds' of the 2018 Science High School Curriculum.

The findings for the comparison of the 9th grade science high school chemistry textbook and the 9th grade chemistry textbook in terms of the number of experiments and their distribution to the units are given in Figure 2.

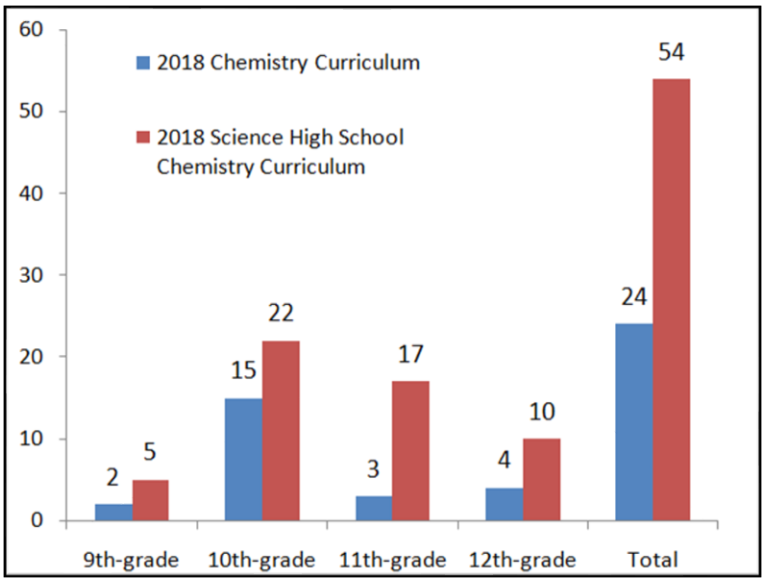

Figure 2. Comparison of 9th grade science high school chemistry textbook and 9th grade chemistry textbook in terms of distribution and number of experiments according to grades

When the science high school chemistry textbook and the chemistry textbook are compared in terms of the number of experiments in the textbooks, it was found that while there are 54 experiments in the science high school chemistry textbook, there are 24 experiments in the chemistry textbook.

Findings Regarding the Third Research Question

In the third research question, it was investigated to what extent the experiments/activities in the chemistry textbooks met the dimensions of "gathering data by experimenting", "making inferences using the data", "interpreting" and "generalizing". For this purpose, firstly, analyses of the textbooks for each class are shown in separate tables below (Tables 7, 8, 9, and 10) and then, the findings of the experiments in all classes regarding these dimensions were compared and the findings are shown in Table 11.

Table 7. Findings Regarding Dimensional Analysis of Experiments/Activities in the 9th grade Chemistry Textbook

Experiment No	Basic SPS						Experiment confirmation SPS			Make inferences	Interpretation	Generalization
	O	M	Cl	RD	N/S	Co	P	VI	OD			
1	-	+	-	+	-	-	-	-	-	+	+	+
2	+**	+	-	+	-	+*	-	-	-	+	-	-
Total	1	2	-	2	-	1	-	-	-	2	1	1

* Drawing graphics
**Not direct observation

As can be seen from Table 7, in the 9th grade chemistry textbook, students are expected to make observations only in one experiment, and this observation was not directly expressed as "observe", and it was decided by inferring from the explanations that this is an observation skill (O). It was determined that they were expected to measure (M) and record data (RD) in two experiments and in one experiment there was the procedure for communication skill (Co). On the other hand, it can be seen from Table 7 that no guidance has been made for the development of basic SPS such as classification (Cl) and number-space relationship (N/S), and also experimental confirmation SPS such as prediction (P), variable determination (VI) and operational definition (OD). It was determined that in two of the experiments, students were asked to make inferences, and in one experiment, they were asked to interpret and generalize the result of the statement.

Table 8. Findings Regarding Dimensional Analysis of Experiments/Activities in the 10th grade Chemistry Textbook

Experiment No	Basic SPS						Experiment confirmation SPS			Make inferences	Interpretation	Generalization
	O	M	Cl	RD	N/S	Co	P	VI	OD			
1	+	+	-	+	+	+	-	-	-	+	-	+
2	+	+	-	+	-	-	-	-	-	+	+	-
3	+	+	-	+	-	-	-	-	+	+	+	-
4	+	-	-	-	-	-	-	-	-	+	-	+
5	-	+	-	-	-	-	-	-	-	-	-	-
6	-	+	-	-	-	-	-	-	-	+	-	+
7	+	+	-	+	-	+*	-	-	-	-	+	-
8	+	+	-	-	-	-	-	-	-	+	-	-
9	-	+	-	-	-	-	-	-	-	+	-	-
10	+	+	-	-	-	-	-	-	-	+	-	-
11	+	+	-	+	-	+	-	-	-	+	+	+
12		+	+	+	-	+	-	-	-	+	+	+
13	+	+	-	-	+		-	-	-	+	-	-
14	+	+	-	-	-	-	-	-	-	+	-	-
15	+	-	-	-	-	-	-	-	-	+	+	-
Total	11	13	1	6	2	4	-	-	1	13	6	5

As can be seen from Table 8, in 11 of the 15 experiments in the 10th grade chemistry textbook, students were required to observe (O), measure in 13 experiments, classify (Cl) in one experiment, record data (RD) in six experiments, make numerical calculations (N/S) in two experiments, and a process that would improve communication skill (Co) in four experiments are expected to do. On the other hand, while no guidance was given to the development of experimental confirmation PPS, such as prediction (P) and variable identification (VI) skills in experiments, operational definition (OD) was included in the experiment. While students were expected to make inferences in 13 of the experiments, it was

determined that they were asked to interpret the results of the experiments in six experiments and to generalize the results in five experiments.

Table 9. Findings Regarding Dimensional Analysis of Experiments/Activities in the 11th grade Chemistry Textbook

Experiment No	Basic SPS						Experiment confirmation SPS			Make inferences	Interpretation	Generalization
	O	M	Cl	RD	N/S	Co	P	VI	OD			
1	+	+	-	+	+		-	-	-	+	+	+
2	-	+	-	+	-	-	-	-	-	+	+	+
3	-	+	-	+	+	+*	-	-	-	+	+	-
Total	1	3	-	3	2	1	-	-	-	3	3	2

* Drawing graphics

As seen in Table 9, students are expected to make observation (O) in only one of three experiments in the 11th grade chemistry textbook, to measure (M) in three experiments, to record data (RD) in three experiments, to make numerical calculations (N/S) in two experiments, and to interpret graphics in a way to improve communication skill (Co) in one experiment. In all of the experiments, there is no guidance for the classification skill (Cl) from the basic BSB. In addition, it is seen that no direction was made for experiment confirmation SPS development in any of the experiments. While students were expected to make inferences and interpretations in all of the experiments, it was determined that they were asked to generalize the findings of the experiment in two experiments.

Table 10. Findings Regarding Dimensional Analysis of Experiments/Activities in the 12th grade Chemistry Textbook

Experiment No	Basic SPS						Experiment confirmation SPS			Make inferences	Interpretation	Generalization
	O	M	Cl	RD	N/S	Co	P	VI	OD			
1	+	+	-	-	-	+	-	-	-	+	+	+
2	+	+	-	-	-	-	-	-	-	+	+	+
3	-	+	-	-	+	-	-	-	-	+	-	-
4	-	+	-	-	-	-	-	-	+	+	-	-
Total	2	4	-	-	1	1	-	-	1	4	2	2

As can be seen from Table 10, in two of the four experiments in the 12th grade chemistry textbook, students are expected to make an observation (O), make a measurement (M) in all experiments, make numerical calculation (N/S) in one experiment, and perform

operations that will improve communication skill (Co) in one experiment. In all of the experiments, there is no guidance from the basic BSB to the ability to classify (Cl) and data recording (RD) skills. In addition, it can be seen from Table 10 that none of the experiments provided any guidance for the development of experiment confirmation SPS such as prediction (P), and variable identification (VI) skills. In only one experiment, students are expected to perform operations related to operational definition (OD) skill. While the students were expected to make inferences in all of the experiments, it was determined that they were asked to interpret the results of the experiment in two experiments and to generalize the results in two experiments.

Finally, the comparison of the results of the dimensional analysis of the experiments in the textbooks at all grade levels is given in Table 11.

Table 11. Comparison of Experiments/Activities in Chemistry Textbooks according to Dimensional Analysis

Grade Level	Number of experiments	Basic SPS						Experiment confirmation SPS			Make inference		
		O	M	Cl	RD	N/S	Co	P	VI	OD		Interpretation	Generalization
9	2	1	2	-	2	-	1	-	-	-	2	1	1
10	15	11	13	1	6	2	4	-	-	1	13	6	5
11	3	1	3	-	3	2	1	-	-	-	3	3	2
12	4	2	4	-	-	1	1	-	-	1	4	2	2
Total	24	15	22	1	11	5	7	-	-	2	22	12	10

As can be seen from Table 11, as a result of the Basic SPS analysis included in the first dimension, the most skill type was 'measurement' (M) and in 22 experiments the measuring skill was addressed, followed by 'observation' (O), 'data recording' skill (RD). followed by communication (Co) and the 'number/space relation' (N/S). It is seen that there is only one experiment for which action is requested for the 'Classification' (Cl) skill. It was determined that experiment confirmation SPS was only asked to make an 'operational definition ' (OD). In none of the experiments, it was seen that no guidance was given for predicting (P) and variable identification (VI) skills.

Conclusions and Suggestions

In the study, firstly, the acquisitions of the 2018 Chemistry Curriculum including laboratory/experimental studies were examined, and it was concluded that the acquisitions that include explanations about experimental studies are approximately 16% of the total acquisitions of the curriculum. When the percentages of the acquisitions related to the experimental studies are examined according to the grade levels, it was determined that the grade level with the most experimental work in the explanation part was the 10^{th} grade, and this percentage was approximately 35%. This situation can be considered as an indication that the 2018 Chemistry Curriculum partially attaches importance to experimental studies. When this result is compared with the percentage of the acquisitions in the 2018 Science High School Curriculum related to the experimental study, it is seen that the Science High School Curriculum's acquisitions are twice (31.1%) compared to the 2018 Chemistry Curriculum's acquisitions (Nakiboğlu, 2021). The fact that the experimental study acquisitions are high in Science High School Curriculum is compatible with the established purpose of the science high school and the philosophy of this curriculum. It has been also determined that the number of acquisitions related to experimental studies in the 2018 Science High School Curriculum at each grade level is higher than the 2018 Chemistry Curriculum, the number of acquisitions involving the least experimental studies in both curricula is at the 9^{th} grade level, and the number of acquisitions containing the most experimental studies is at the 10^{th} grade level. The importance of experimental studies for science high school students is revealed with the following statement under the title of the basic philosophy and general objectives of the 2018 Science High School Chemistry Curriculum.

"…With the Science High School Chemistry Curriculum, which was prepared in accordance with the emerging needs, it is aimed that students spend more time in the laboratory environment and prepare projects to encourage them to become scientists and do scientific studies" (MoNE, 2018b, p.12).

Although students in science high schools need to spend more time in the laboratory, the important point for other high schools is how the experiments in this process are carried out. In acquiring scientific knowledge, students should not only take part in laboratory studies but also these studies should be carried out based on research and inquiry. This is important for students attending other types of high school as well as for students attending science high school. For this reason, it is extremely important to provide guidance and to plan in a way that will provide many skills in the conduct of the experiments. For this reason, the preparation of

experimental studies in school textbooks as a guide for teachers and their use will be the most important basis for structuring scientific knowledge. Based on these considerations, in the second part of this study, dimensional analyzes for experiments in chemistry textbooks are also included.

The experiments placed in the chemistry textbooks were analyzed for the four dimensions "gathering data by experimenting", "making inferences using the data", "interpreting" and "generalizing". The first dimension, "gathering data by experimenting", is directly related to the basic SPS and experiment confirmation SPS. As a result of this analysis for SPSs, it is seen that the experiments mostly focus on the basic SSBs, and they focus especially on “observation” and “measurement” skills. Experiments do not seem to give much space to high-level SPS development. Basic SPSs form the basis of high-level skills (Padilla, 1990) and it has been stated that these skills can be acquired by students starting from the pre-school period, while high-level skills can be gained from the second level of primary education (Aydoğdu et al., 2012). For this reason, it can be said that it is much more important for the experiments in chemistry textbooks to focus on higher SPSs. On the other hand, In none of the experiments, it was concluded that there was no guidance for improvement of experiment confirmation SPS such as predicting and variable identification skills. So, it can be said that chemistry textbooks do not give the necessary importance to the development of SPS. Padilla et al. (1984) also emphasized that scientific process skills should be strongly included in science programs and classrooms, whether they are considered as the way scientists think or as survival strategies for a changing world.

Another important conclusion about the study belongs to the textbook analysis of the other three dimensions. It was determined that inferences were made using the data in 22 of the 24 experiments in the chemistry books, interpretations were made in 12 experiments, and the results were generalized in only 10 experiments. Based on these results, at the end of the experiments in the chemistry textbooks, although students are expected to make inferences based on the results of the experiments, it is not required to interpret and generalize the results in half of the experiments. Özmen (2004), in his study on the reasons why teachers do not use the laboratory in chemistry classes, determined that the instructions and explanations about the experiments in the books were not found sufficient for nearly half of the teachers. In addition, it was determined that the experiments in the textbooks did not guide the students much and the teachers thought that these experiments were not based on research and inquiry. Looking at the years of this study, it can be said that although the programs have changed in

the intervening 18 years, the guidance of the chemistry textbooks regarding the experiments has not changed much.

At the end of the study, it can be said that the 2018 Chemistry Curriculum partially meets the purpose of including experimental studies in both its purpose and the explanations in the acquisitions. Although there is a quantitative harmony between the books and the outcome, when the experimental contents are examined, it can be said that this harmony does not fully comply with the curriculum's goal, and the way the experiments are given in the chemistry textbooks is not written in a way to fully guide the teachers. For this reason, the first suggestion is for the parts written about experimental studies during the writing of the textbooks.

In the writing of experimental activities in chemistry textbooks, a more skill development-oriented teacher and teacher-guiding way should be adopted. In fact, as it was seen in the previous study on science high schools (Nakiboğlu, 2021), it does not seem possible to carry out this number of experiments during the course hours in the program and to follow a path based on research and inquiry. For this reason, to achieve this goal of the program, it can be suggested that separate course hours should be included in the program, and guidebooks should be prepared to guide teachers.

Kimya Ders Kitaplarındaki Deneylerin 2018 Kimya Dersi Öğretim Programının Deneysel Çalışmaya Yönelik Amacı Açısından Analizi ve Fen Lisesi Durumu ile Karşılaştırılması

Özet:

Bu çalışma, 2018 Kimya Dersi Öğretim Programının deneysel çalışmalar hedefinin programın kazanımlarıyla ne ölçüde örtüştüğünü ve lise kimya ders kitaplarının bu amaca yönelik olarak ne ölçüde hazırlandığını incelemeyi amaçlamaktadır. Çalışma aynı zamanda kimya ders kitaplarındaki etkinliklerin 2018 Kimya Dersi Öğretim Programının dört boyutunu (deneyerek veri toplama, verileri kullanarak çıkarım yapma, yorumlama ve genelleme)) ne ölçüde karşıladığını değerlendirmeyi de amaçlamaktadır. Son olarak bu durumun 2018 Fen Lisesi Kimya Dersi Öğretim Programı ile karşılaştırılması, benzerlik ve farklılıklarının belirlenmesi hedeflenmiştir. Bu amaçlar doğrultusunda öncelikle 2018 Kimya Dersi Öğretim Programında deneysel çalışmaları içeren kazanımlar belirlenmiştir. Daha sonra 9., 10., 11. ve 12. sınıf kimya ders kitaplarındaki deneyler analiz edilmiştir. Ders kitabı analizi için iki yol kullanılmıştır. İlk aşamada 2018 Kimya Dersi Öğretim Programındaki kazanımlar ile ders kitaplarındaki deneylerin ne ölçüde örtüştüğü ve deneylerin ünitelere göre nasıl dağıldığı belirlenmiştir. İkinci aşamada, ders kitaplarında yer alan deneyler, 2018 Kimya Dersi Öğretim Programının dört boyutuna göre bir dereceli puanlama anahtarı aracılığıyla analiz edilmiştir. Çalışmada, deneysel çalışmalarla ilgili açıklamalar içeren kazanımların 2018 Kimya Dersi Öğretim Programı toplam kazanımlarının yaklaşık %16'sına karşılık geldiği sonucuna ulaşılmıştır. Ayrıca, BSB analizi sonucunda, deneylerin daha çok temel BSB'lere odaklandığı, özellikle "gözlem" ve "ölçüm" becerilerine odaklanıldığı belirlenmiştir.

Anahtar kelimeler: 2018 Kimya Dersi Öğretim Programı, lise kimya ders kitabı, deneysel çalışma.

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