

Research Article

The Examination of Turkish High School Chemistry Textbooks for Values

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Abstract

The objective of this study is to analyze the texts within high school chemistry textbooks in Türkiye with respect to the values outlined in the chemistry curriculum. The study employed a document analysis approach. The sample of the study consisted of four chemistry textbooks, one from each of the 9th, 10th, 11th and 12th grade levels. As a data collection tool in the study; the criteria including values and its indicators (attitudes and behaviours) related to the values determined by the Turkish Board of Education were used. Descriptive analysis was used to analyse the data. It was concluded that the most common values in Turkish high school chemistry textbooks were "responsibility" and "self-control", while the least common values were "friendship" and "justice". In addition, the value of "honesty" was not encountered in the textbooks of any grade level. In conclusion, it was proposed that greater emphasis should be placed on incorporating values into chemistry textbooks.



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Introduction

In the broadest sense, values are regarded as the principles and virtues that guide an individual's life. Values are defined as an individual's inner realities reflected through behaviours, expectations, habits, beliefs and relationships (Gamage et al., 2021). Values form the foundation of an individual's thought structure and behaviours (Schwartz, 2012). They are essential in shaping an individual's decisions and preferences. Certain values may be innate at birth and are subsequently shaped by various factors, including family, school, the surrounding community, and numerous other influences (Matthews et al., 2007). Values are important in sociology, psychology, anthropology and many other disciplines. While values vary according to individuals and cultures, there are universal values commonly shared in many communities (Schwartz, 2012). In order for individuals to be accepted in society, it is

important for them to adopt the common values accepted by the society (Ozdemir et al., 2012). Considering that one of the aims of education is to raise students as individuals who adopt the basic values of the society in which they live and reflect them on their behaviour, it becomes evident that values education should constitute a significant element of the educational system (Thambusamy & Elier, 2013).

Values education is the teaching and learning of values in a conscious way. Values education is organised according to the demands, moral understanding and culture of the society in which we live. Accordingly, the aim of values education is to ensure that behaviours reflecting social culture become the character of individuals. In this way, individuals are accepted by the society and take their place in it. Values education, like in the rest of the world, has become increasingly important in Türkiye in recent years and is one of the fundamental issues being integrated into the education system. While the Turkish National Education system aims to provide students with knowledge and skills of different disciplines, it also emphasizes values education. The idea that values should be acquired by students by blending them with disciplinary knowledge and skills is adopted. Thus, the new curriculum is based on the view that values are embedded and integrated with the content (Ministry of National Education [MoNE], 2018). Instilling values in students supports not only their academic development but also their social and emotional growth. Fundamental values such as respect, responsibility, and honesty facilitate individuals' adaptation to society and the establishment of healthy relationships.

Until 2005, it is seen that value education was not included in the curricula in a systematic and regular way, and some values (such as respect, responsibility, scientificity) were implicitly included not in all courses but in only a few courses (Life Science, Religious Culture and Ethics) (Ulusoy, 2019). However, as a result of the curriculum changes in 2005, values such as sensitivity to nature, responsibility, respect, cooperation and scientificity were included in the curriculum of many courses (Social Sciences, Science, Physical Education and Turkish) in middle school (Kart et al., 2019). In the 2010 National Education Council, an important decision was taken that values education should be included in both lessons and extracurricular activities at all levels of education, starting from pre-school (MoNE, 2010). Based on these developments, in the all curricula updated by MoNE in 2018, the title "Our Values" was included and ten values such as "responsibility", "love", "benevolence",

“friendship”, “justice”, “honesty”, “patience”, “patriotism”, “respect” and “self-control” were mentioned in this title (MoNE, 2018).

The most important materials that ensure the reflection of curricula in learning environments are textbooks. Textbooks are one of the most widely used teaching materials by both teachers and students. Textbooks replace teachers in their absence. When students study alone, the first resource they refer to is textbooks (Yildirim, 2006; Zerman-Kepçeoğlu, & İrez, 2023). Moreover, teachers are often influenced by textbooks when deciding on the information, examples and activities to be covered in their lessons. Some researchers even claim that textbooks have a primary influence on the teaching process (Marker & Mehlinger, 1992). Although teachers take the curriculum into account as a general framework, in practice, they conduct their lessons according to textbooks.

Textbooks can be written by authors, who may be independent or assigned by the Ministry of Education in Türkiye. Before being taught in schools, draft textbooks are reviewed by a textbook review commission appointed by the Board of Education, which consists of experts in the field. These commissions evaluate draft textbooks in terms of various criteria such as “scientific”, “pedagogical”, “compliance with the curriculum”, “visual design”, and “grammar”. Since 2018, with the emphasis on values in all curricula, a new dimension has emerged in the evaluation of textbooks, and new criteria have been determined regarding it. Thus, in the process of writing and evaluating textbooks in Türkiye, new criteria have been identified in relation to values such as (i) the content should reflect the values in the curricula, (ii) values should be given implicitly and integrated with the content, (iii) the content that contradicts the values should not be included, and (iv) the texts containing the values should be suitable for the developmental characteristics of students (MoNE, 2023).

In recent years, the increasing emphasis on values in the Turkish education system has prompted researchers to take action, leading to a rise in the number of studies related to values education. When examining the studies conducted on values education in Türkiye, it has been observed that a significant portion focuses on the analysis of documents such as textbooks, literary works in terms of the values they contain (e.g., Meco & Costu, 2023; Sevim & Er, 2023; Ünal & Benzer, 2024a,b; Yilmaz & Kiran, 2023). In contrast, in the international literature, there are relatively few studies that analyse textbooks in terms of values. When the studies analysing the textbooks in Türkiye in terms of values are analysed, it is seen that the

majority of them were conducted for the textbooks of the courses on social fields (Social Sciences, Turkish, English and Religious Culture and Ethics) at primary education level (Costu, 2024). However, values are included in the curriculum of all disciplines (MoNE, 2018). Therefore, it is expected that values should be included in the textbooks of all courses, including chemistry. The presence of values in chemistry textbooks not only aids students in learning chemical processes but also contributes to their development as individuals with scientific, ethical, and environmental responsibilities. This enables them to better understand both their scientific and social responsibilities (Ünal & Benzer, 2024a, b). However, when the studies analysing chemistry textbooks are examined, it was seen that they mostly examined the textbooks in terms of scientific process skills, elements of the nature of science, experiments, analogies, types and levels of questions contained in them, whereas there were no studies analysing chemistry textbooks according to values (e.g., Derman & Tufan, 2022; Koray et al., 2006; Nakiboğlu, 2021; Şen & Temel, 2023; Üner et al., 2014).

This study, which examines the extent to which values are integrated into chemistry textbooks in Türkiye, offers valuable insights that can contribute to educational research and practice beyond national boundaries. By providing a detailed analysis of the representation of values within a specific curriculum context, our findings serve as a comparative benchmark for researchers in other countries investigating the incorporation of values education into science curricula. This research highlights the gaps and opportunities in embedding ethical and social dimensions into chemistry education, which may inspire similar studies in diverse educational settings. For education researchers globally, this study contributes to the growing body of literature on values education, fostering cross-cultural dialogue and collaboration to address universal challenges in preparing students not only as skilled scientists but also as ethically conscious citizens.

The aim of this study is to examine the extent to which high school (9th, 10th, 11th and 12th grade) chemistry textbooks in Türkiye include values, which are emphasized in the curriculum. In this context, textbooks at each grade level were analysed on the basis of unit and value type. To address this purpose, the study sought to answer the following questions:

- What is the distribution of value numbers and value types by unit in the chemistry textbooks examined?

- What is the distribution of value numbers and value types by grade level in the chemistry textbooks examined?

Method

Document analysis model was used in the study. Document analysis is one of the qualitative research methods that enables the systematic examination of printed and electronic document contents (Bowen, 2009). The documents to be examined in this study are four chemistry textbooks, one from each of the 9th, 10th, 11th and 12th grade levels, the digital version of which is available on the Turkish MoNE's Educational Information Network (EBA) platform. EBA is a digital education platform established by the MoNE of Türkiye. EBA provides online course materials (textbooks, quizzes, educational games and content) that teachers and students need (EBA, 2024).

As a data collection tool in the study; the criteria including values and its indicators (attitudes and behaviours) related to the values determined by the Turkish Board of Education were used (see Appendix 1). Descriptive analysis was used to analyse the data. This method aims to present the qualitative data obtained in an organized and interpreted manner by classifying them according to predetermined themes. In this process, cause-and-effect relationships are established between the findings, and comparisons are made if necessary (Yildirim & Simsek, 2008). In the analysis process, the texts in the textbooks were analysed based on the framework given in Appendix 1. Sentences containing the value directly or implicitly in the texts were determined. The analyses were conducted independently by two researchers. Cohen kappa coefficient was used to calculate the agreement between the coders (Cohen, 1960). Inter-coder agreement was found to be 0.92.

Findings

In this section, the values included in high school chemistry textbooks at each level, their frequencies and the units in which they are included are presented in the form of tables. The values included in the ninth grade chemistry textbook and their distribution according to the units are given in Table 1.

Table 1. Values in the 9th grade textbook and their distribution by units

Values	Units (f)					Total
	Chemical Science	Atom and Periodic System	Interactions between Chemical Species	States of Matter	Nature and Chemistry	
Benevolence	-	-	2	-	-	2
Friendship	-	-	1	-	-	1
Honesty	-	-	-	-	-	-
Justice	-	-	1	-	-	1
Love	1	-	2	-	-	3
Patience	1	1	6	1	-	9
Patriotism	7	-	14	-	18	39
Respect	-	-	1	-	-	1
Responsibility	30	-	2	-	37	69
Self-Control	25	-	6	-	11	42
Total	64	1	35	1	66	167

As Table 1 shows, the ninth grade textbook contains a total of 167 sentences in which values are mentioned. An analysis of the distribution reveals that "responsibility" is the most prevalent value, while the least common values are "justice", "friendship" and "respect". In addition, it was determined that the value of "honesty" was not included in the textbook at all. When the distribution of values according to the units in the ninth grade textbook was analysed, it was seen that the values were mostly addressed in "Nature and Chemistry" and the least in "Atom and Periodic System" and "States of Matter" units.

The excerpts below demonstrate the integration of some values into the content of the 9th grade chemistry textbook.

"In the early years of the Republic, despite all kinds of scarcity and difficulties, students were sent abroad. The aim was to transfer scientific and technological advancements to our country through these students. In the telegram he sent to them, Atatürk stated: 'I am sending you as a spark; you must return as flames'. (In Turkish, Cumhuriyetin ilk yıllarında her türlü yokluk ve imkânsızlığa rağmen yurt dışına öğrenci gönderilir. Amaç, bilimsel ve teknolojik gelişmenin bu öğrenciler sayesinde ülkemize taşınmasıdır. Atatürk onlara gönderdiği telgrafta: 'Sizi bir kıvılcım olarak gönderiyorum; alevler olarak geri dönmelisiniz.' demiştir)". (Page 25).

These sentences emphasize the value of "responsibility" particularly its sub-dimension of "being responsible for oneself, one's environment, one's homeland, one's family", as well as the value of "patriotism" specifically its sub-dimension of "caring about

the community”, reflected in the decision to send students abroad despite hardships and the intention that they contribute to the country’s development.

“In the chemistry laboratory, one must follow safety rules while conducting experiments to avoid harm and prevent accidents. In addition to laboratory safety regulations, students should also be knowledgeable about how to work safely with chemicals. (In Turkish, Kimya laboratuvarında, deney yaparken zarar görmemek ve bir kaza yaşamamak için güvenlik kurallarına uygun davranılmalıdır. Laboratuvar güvenlik kurallarının yanı sıra kimyasallarla güvenli bir şekilde nasıl çalışılacağı konusunda da bilgi sahibi olunmalıdır)”. (Page 38).

This passage addresses the value of “responsibility” particularly its sub-dimension of “being responsible for oneself, one’s environment, one’s homeland, one’s family”, as well as the value of “self-control” under the key concept of “controlling one’s own behaviour”.

“Nobel Prize-winning scientist Aziz Sancar also purchased a house in Chapel Hill in 2008 with \$1 million of his own savings. He named it the Carolina Turkish House. He and his American wife, Gwen, opened their house to Turkish students who came to the US for doctoral studies so they wouldn’t experience the same difficulties he did, using it as both a dormitory and a cultural center. He also opened a Turkish language course for interested Americans. (In Turkish, Ayrıca Nobel Ödüllü bilim insanı Aziz Sancar, 2008 yılında kendi birikimi olan 1 milyon dolar ile Chapel Hill kasabasında bir ev satın aldı. Buraya Carolina -Türk Evi- adını verdi. Amerikalı eşi Gwen ile birlikte ABD’ye doktora için gelen Türk öğrenciler kendi yaşadığı zorlukları yaşamamasın diye evini o çocuklara açtı ve burayı hem yurt hem de kültür merkezi olarak kullanmaya başladı. İlgi duyan Amerikalılar için bir de Türkçe eğitim kursu açtı)”. (Page 134).

In this excerpt, Aziz Sancar’s awareness of the challenges associated with studying abroad and his considerate behaviour toward Turkish students, as described in the text, highlights the value of “friendship” through the sub-dimension of “altruism”. Moreover, his willingness to “making sacrifices” his own comfort and demonstrate “being compassionate” toward students from his homeland underscores the value of “love”. His view of assisting Turkish students as a duty to the country that educated him reflects the value of “responsibility”, particularly through the sub-dimension of “being responsible for oneself, one’s environment, one’s homeland, one’s family”. His “solidarity” with Turkish students and “his caring about the community” emphasize the value of “patriotism”. The value of “benevolence” is emphasized through the sub-dimensions of “being generous”, “hospitable”, and “sharing”.

Table 2 presents the frequencies of the values found in the tenth-grade chemistry textbook and their distribution across the units.

Table 2. Values in the 10th grade textbook and their distribution by units

Values	Units (f)				Total
	Basic Laws of Chemistry and Chemical Equations	Mixtures	Acids, Bases and Salts	Chemistry is All Around	
Benevolence	-	-	-	-	-
Friendship	-	-	-	1	1
Honesty	-	-	-	-	-
Justice	-	-	-	-	-
Love	-	-	-	-	-
Patience	2	-	-	1	3
Patriotism	3	2	-	10	15
Respect	-	-	-	-	-
Responsibility	2	1	10	6	19
Self-Control	3	5	8	22	38
Total	10	8	18	40	76

As can be seen in Table 2, the tenth grade textbook contains 76 sentences in which values are mentioned. The distribution indicates that "self-control" is the most frequently occurring value, while the least common values is "friendship". In addition, it was determined that "justice", "honesty", "respect", "love" and "benevolence" were not included at all. When the distribution of values according to the units in the tenth grade textbook was analysed, it was seen that the values were mostly included in the "Chemistry is All Around" unit and the least in the "Mixtures" unit.

The excerpts below demonstrate the integration of some values into the content of the 10th grade chemistry textbook.

"In addition, people working in dusty environments in the industry wear dust masks to capture airborne dust. (In Turkish, Ayrıca endüstride tozlu ortamlarda çalışan insanlar havadaki tozu tutması için toz maskeleri takarlar)". (Page 117).

This statement mentions that people protect themselves from dust. Therefore, the value of "self-control" is emphasized through the sub-dimension of "controlling one's own behaviour".

"Acid rain can be minimized by taking certain precautions. Using less electricity at home, choosing public transportation over cars, and cycling or walking whenever possible can reduce the emission of harmful gases. These measures save energy, contributing to the national economy and preventing environmental pollution. This will leave a cleaner world for future generations. (In Turkish, Asit yağmurları bazı önlemler alınarak en aza indirgenebilir. Evlerde daha az elektrik kullanmak, otomobiller yerine toplu taşıma araçlarını

tercih etmek, bisiklete binmek veya mümkün olduğunca yürümek zararlı gazların salınımını azaltır. Bu önlemlerle enerji tasarrufu sağlandığı için ülke ekonomisine katkıda bulunulur ve çevre kirliliği de engellenebilir. Böylece gelecek nesillere daha temiz bir dünya bırakılabilir”. (Page 159).

In these statements, the value of “responsibility” is emphasized through the sub-dimension of “being responsible for oneself, one's environment, one's homeland, one's family” and the value of “patriotism” is emphasized through the sub-dimensions of “being sensitive to historical and natural heritage” and “caring about community”.

Table 3 displays the frequencies of the values present in the eleventh-grade chemistry textbook and their distribution across the units.

Table 3. Values in the 11th grade textbook and their distribution by units

Values	Units (f)						Total
	Modern atom theory	Gases	Liquid Solutions and Solubility	Energy in Chemical Reactions	Speed in Chemical Reactions	Equilibrium in Chemical Reactions	
Benevolence	-	1	1	-	-	-	2
Friendship	-	1	-	-	-	-	1
Honesty	-	-	-	-	-	-	-
Justice	-	-	-	-	-	-	-
Love	1	1	-	-	2	-	4
Patience	1	-	-	-	2	1	4
Patriotism	1	1	-	-	6	-	8
Respect	1	1	1	-	1	-	4
Responsibility	-	8	1	-	2	1	12
Self-Control	-	8	5	-	4	1	18
Total	4	21	8	-	17	3	53

As seen in Table 3, the eleventh grade textbook contains 53 sentences in which values are mentioned. The distribution shows that the most common value is “self-control”, while the least common values is “friendship”. Additionally, it was found that “justice” and “honesty” were entirely absent. When the distribution of values according to the units in the eleventh grade textbook was analysed, it was seen that the values were mostly included in the “Gases” unit and the least in the “Equilibrium in Chemical Reactions” unit. In addition, it was determined that no value expression was included in the “Energy in Chemical Reactions” unit.

The excerpts below demonstrate the integration of some values into the content of the 11th grade chemistry textbook.

“Deodorant packaging often includes a warning to avoid leaving it in direct sunlight. When left in direct sunlight, the gases inside the container increase in temperature due to the sun’s heat. The pressure of the increased gases also increases. If the container cannot withstand the increased pressure, it can explode. Therefore, containers containing gas should not be left in direct sunlight or exposed to heat. (In Turkish, Deodorantların ambalajlarında genellikle güneşte bırakmayın uyarısı bulunur. Güneşte bırakılan kutunun içindeki gazların güneşten gelen ısı etkisi ile sıcaklığı artar. Sıcaklığı artan gazların basıncı da artar. Basıncı artışı dayanamayan kutu patlayabilir. Bu nedenle içinde gaz bulunan kutular güneşte bırakılmamalı ya da ısıyla teması önlenmelidir)”. (Page 87).

In these statements, the value of “self-control” is emphasized through the sub-dimensions of “controlling one’s own behaviour” and “taking responsibility for one’s own behaviour” and the value of “responsibility” is emphasized through the sub-dimension of “being responsible for oneself, one’s environment, one’s homeland, one’s family”.

“Ayşe wants to use the chemicals in the school laboratory to remove an oil stain from her sweater. She asks her teacher for permission. The teacher tells Ayşe that she will only give permission if she knows the chemicals needed to clean her sweater and how these chemicals interact with the oil stain. (In Turkish, Ayşe, kazağındaki yağ lekesini çıkarmak için okul laboratuvarındaki kimyasallardan yararlanmak istiyor. Bu amaçla öğretmeninden izin istiyor. Öğretmen, Ayşe’ye kazağını temizlemek için gereken maddeleri ve bu maddeler ile yağ lekesi arasında nasıl bir etkileşim olduğunu bilmesi hâlinde kendisine izin vereceğini söylüyor)”. (Page 126).

In this text, Ayşe’s act of requesting permission from her teacher emphasizes the value of “respect” through the sub-dimension of “considering the position, characteristics, and situation of the interlocutor”. Additionally, the teacher’s assistance to Ayşe highlights the value of “benevolence” through the sub-dimension of “cooperating”.

“He went to the United States as a scholarship student in 1953. He graduated with honors from the Department of Chemical Engineering at the University of California in 1956. He completed his master’s degree in 1957 at the Massachusetts Institute of Technology (MIT) in eight months and won the Sloan Research Award, the world’s most prestigious award. He completed his doctorate in theoretical chemistry at Berkeley. In 1960, he became a faculty member at Yale University. (In Turkish, 1953 yılında burslu öğrenci olarak ABD’ye gitti. 1956’da Kaliforniya Üniversitesi Kimya Mühendisliği Bölümünü dereceyle bitirdi. Yüksek lisansını 1957’de Massachusetts Teknoloji Enstitüsünde (MIT) 8 ayda tamamladı ve bilim dünyasının en önemli ödülü olan Sloan Araştırma ödülünü kazandı. Berkeley’de kuramsal kimya alanında doktorasını tamamladı. 1960’ta Yale Üniversitesinde öğretim üyesi oldu)”. (Page 214).

Here, by presenting a brief excerpt from Oktay Sinanoğlu's achievements, the value of "patience" is emphasized through the sub-dimension of "being determined" and the value of "patriotism" is emphasized through the sub-dimension of "being hardworking".

Table 4 presents the frequencies of the values included in the twelfth-grade chemistry textbook and their distribution across the units.

Table 4. Values in the 12th grade textbook and their distribution by units

Values	Units (f)				Total
	Chemistry and Electricity	Introduction to Carbon Chemistry	Organic Compounds	Energy Resources	
Benevolence	1	-	-	1	2
Friendship	1	-	1	1	3
Honesty	-	-	-	-	-
Justice	1	-	-	-	1
Love	1	-	-	-	1
Patience	3	-	-	1	4
Patriotism	8	-	2	35	45
Respect	-	-	-	3	3
Responsibility	8	-	5	33	46
Self-Control	8	-	9	10	27
Total	31	-	17	84	132

Table 4 shows that the twelfth grade textbook contains a total of 132 value statements. Analysing the distribution, it was seen that the most common value is "responsibility" and the least common values are "justice" and "love". In addition, it was determined that the value of "honesty" was not included in the textbook at all. Considering the distribution of values according to the units in the twelfth grade textbook, it was seen that the values were mostly included in the "Energy Resources" unit and the least in the "Organic Compounds" unit. In addition, it was determined that no value expression was included in the "Introduction to Carbon Chemistry" unit.

The excerpts below demonstrate the integration of some values into the content of the 12th grade chemistry textbook.

"Since the changes occurring during the experiment require a certain amount of time, do not rush; wait patiently for the result of the experiment. (In Turkish, Deney sırasında meydana gelecek değişiklikler belirli bir süre gerektirdiğinden acele etmeyiniz, deneyin sonucunu sabırla bekleyiniz"). (Page 32).

In this passage, the value of "patience" is emphasized through the sub-dimension of "knowing how to wait".

“Batteries are generally manufactured using heavy metals such as mercury, cadmium, and lead. Therefore, used batteries cause various diseases. Used batteries can cause neurological disorders, central nervous system disorders, cancer, kidney and liver diseases. The presence of mercury in nature, even in trace amounts, can cause very serious harm. Studies have shown that 1 gram of mercury in used batteries, if released into the environment, can poison thousands of liters of clean water. If just one AA battery is thrown into the sea, the mercury in the battery can poison many fish. Scientists have shown that if a single AA battery is left in the ground, it will completely poison 6 square meters of soil within a few months. (In Turkish, Piller genellikle cıva, kadmiyum ve kurşun gibi ağır metaller kullanılarak üretilir. Bu nedenle atık piller çeşitli hastalıklara sebep olur. Atık piller; nörolojik bozukluklar, merkezi sinir sistemi, kanser, böbrek ve karaciğer hastalıklarına sebep olabilir. Özellikle cıvanın, eser miktarda dahi olsa, doğada bulunması çok ciddi zararlar ortaya çıkarabilir. Atık pillerde bulunan 1 gram cıvanın doğaya bırakılması hâlinde binlerce litre temiz suyu zehirlediği yapılan araştırmalar sonucunda ortaya konulmuştur. Sadece bir adet kalem pilin denize atılması durumunda pildeki cıva sebebiyle birçok balık zehirlenebilir. Bir adet kalem pilin toprağa bırakılması hâlinde birkaç ay içerisinde çevresindeki 6 metrekare toprağı tamamen zehirleyeceği bilim insanlarının yaptığı çalışmalarla ortaya konulmuştur)”. (Page 57).

In this context, the emphasis on not disposing of batteries into the environment highlights the value of “self-control” through the sub-dimension of “controlling one's own behaviour” the value of “responsibility” through the sub-dimension of “being responsible for oneself, one's environment one's homeland, one's family” and the value of “patriotism” through the sub-dimension of “caring about the community”.

Evaluating high school chemistry textbooks at all levels together, a comparison of the values and their frequencies at each level is given in Table 5.

Table 5. Values and their frequencies in chemistry textbooks at different grade levels

Values	Grades				Total
	9 th	10 th	11 th	12 th	
Benevolence	2	-	2	2	6
Friendship	1	1	1	3	6
Honesty	-	-	-	-	-
Justice	1	-	-	1	2
Love	3	-	4	1	8
Patience	9	3	4	4	20
Patriotism	39	15	8	45	107
Respect	1	-	4	3	8
Responsibility	69	19	12	46	146
Self-Control	42	38	18	27	125
Total	167	76	53	132	428

According to Table 5, when all levels are taken into consideration, it is seen that “responsibility”, “self-control” and “patriotism” values are relatively more common in chemistry textbooks. On the other hand, it was observed that the expressions including the values of “justice”, “friendship”, “benevolence”, “respect” and “love” were quite rare and even the value of “honesty” was not included at all. It was also noticed that the distribution of each value in chemistry textbooks at different levels was similar. For example, while the value of “friendship” was included less than other values at each grade level, the value of “self-control” was included more than other value types. When the number of value statements in chemistry textbooks was analysed in terms of grade level, It was found that the ninth-grade chemistry textbook contained the highest number of value statements, while the eleventh-grade chemistry textbook had the fewest.

The student learning outcomes and contents of the units in which only value expressions are more common are presented in Appendix 2 to provide the audience with more insight. This information was taken from the Chemistry curriculum published by the Turkish MoNE (MoNE, 2018).

Discussion and Conclusion

In this study, the texts in high school chemistry textbooks were examined in terms of the values specified in the chemistry curriculum. In this section, the findings related to the most and least common values, types of values, and the distribution of values across units and grade levels are discussed.

When chemistry textbooks at all grade levels are analysed in terms of the value statements they contain, it is seen that the most common values are “self-control”, “responsibility”, and “patriotism”. This case is also valid at each grade level only the order changes at different grades. For example, while “responsibility” is the most common value in ninth and twelfth grade chemistry textbooks, it is the second most common value in tenth and eleventh grades. The fact that “responsibility”, “self-control” and “patriotism” are the most common values is actually an expected result. This predominance of “self-control”, “responsibility”, and “patriotism” in chemistry textbooks can be explained by the nature of the subject matter and the overarching educational objectives. When chemistry textbooks at all levels are examined, it is seen that some of the units in which these three values are most frequently included are “Chemical Science” and “Nature and Chemistry” in ninth grade, “Chemistry is Everywhere” in tenth grade and “Energy Sources” in twelfth grade. When the

student learning outcomes and contents of these units are examined, it is understood that they are generally on topics such as the effects of chemicals (cleaning products, acids, bases, etc.) or fossil fuels on human health and the environment, the economical use of water, laboratory rules, and the things to be done for the protection of the environment (recycling, renewable energy, etc.) (See Appendix 2). In other words, these units frequently mention “controlling his/her behaviours to protect his/her own health and safety (self-control)”, “behaviours that individuals should exhibit towards themselves, their environment and their families (responsibility)”, “being sensitive to historical and natural heritage and caring for society (patriotism)”. The results regarding the values most frequently included in chemistry textbooks are in harmony with the results of previous related studies in the literature. To illustrate, it was reported that “self-control”, “responsibility”, and “patriotism” were the most emphasized values in physics (Meco & Costu, 2023), middle school science (Yilmaz & Kiran, 2023), and fifth-grade mathematics (Sayin et al., 2019) textbooks.

When chemistry textbooks at all levels were analysed in terms of the value expressions they contained, it was observed that the least common values were “justice”, “friendship”, “benevolence”, “respect” and “love”, and even the value of “honesty” was not included at all. This case is valid for each level, and only the order changes at different grade levels. For example, the tenth grade chemistry textbook does not include the values of “honesty”, “justice”, “respect”, “benevolence”, and “love” at all, while the twelfth grade textbook includes these values to a lesser extent except “honesty”. The values of “honesty” and “justice” constitute the foundations of scientific ethics. Furthermore, the importance of impartiality, accuracy, integrity, and fairness in scientific research is undeniable. Emphasizing these values in the teaching process makes students acquire ethical and fair behaviour. The value of benevolence enables students to adopt the culture of scientific cooperation and solidarity and to realize their social responsibilities. Incorporating the values of love and respect in the teaching process fosters empathy and understanding among students, and helps students develop the habit of respecting the opinions of others during scientific discussions. In chemistry education, placing more emphasis on the values of “justice”, “friendship”, “benevolence”, “respect”, “love”, and “honesty” would also encourage students to become people-oriented and responsible individuals. The relatively limited emphasis on these values in chemistry textbooks may be attributed to the nature and scope of the curriculum, which predominantly focuses on scientific concepts, laboratory

practices, and environmental issues, where values such as “self-control” and “responsibility” are more directly connected to the subject matter. In contrast, values like “justice” or “love” are more abstract and often perceived as belonging to the domain of social sciences, which may lead to their less explicit inclusion in science textbooks. The findings concerning the least frequently occurring values in chemistry textbooks align consistently with the outcomes of prior studies in the literature. For example, it has been found that the least common values are similar in studies conducted by Meco and Costu (2023) on physics, Yilmaz and Kiran (2023) on middle school science, Turker et al. (2023) on geography, and Acar and Yaman Kasap (2020) on biology textbooks.

When chemistry textbooks were analysed according to value types, it was determined that different value types were not equally included in each grade level, and some were not included at all. Moreover, the frequency of each value type in chemistry textbooks at different grade levels is not equal. Accordingly, it is concluded that value types are not distributed evenly in chemistry textbooks. This might stem from the authors of chemistry textbooks not adequately considering values during preparation. Similarly, it can be claimed that the commissions evaluating the candidate textbooks did not show the necessary sensitivity in terms of “compliance with the curriculum” when evaluating the textbooks and did not examine the candidate textbooks in detail in terms of values. In fact, when the guidelines of the Turkish MoNE on the rules to be followed in writing textbooks (MoNE, 2023) are examined, it is stated that textbooks should reflect the values included in the curriculum, but there is no criterion that each value type should be included in equal numbers in textbooks. Therefore, it is an expected result that the frequency of each value type in chemistry textbooks is not equal or close. However, even though their frequency may be different, at least each type of value should be included in the textbooks at an appropriate rate. Because including a value type only a few times throughout the textbook will not be sufficient for students to adopt that value. The findings obtained from this study are in line with many previous studies reporting that different value types are not equally included in textbooks (Acar & Yaman Kasap, 2020; Meco & Costu, 2023; Turker et al., 2023; Ureyen-Cimen & Ozmantar, 2023; Yilmaz & Kiran, 2023).

When chemistry textbooks are evaluated in terms of grade levels, the highest number of values is found in the ninth grade, while the lowest number is found in the eleventh grade. Therefore, it is deduced that chemistry textbooks at different grade levels include

values at different rates. This can be explained by whether the student learning objectives and the content of the units at each level are suitable for value transmission. For example, when the units in the chemistry curriculum are examined, it is seen that the outcomes of the units “Chemical Science” and “Nature and Chemistry” in the ninth grade are suitable for value transfer, whereas the outcomes of the units “Modern Atom Theory”, “Energy in Chemical Reactions” and “Equilibrium in Chemical Reactions” in the eleventh grade are not suitable for value transfer. This is also clearly evident from the table in Appendix 2, which shows the units and objectives in the chemistry curriculum where values are most emphasized. The fact that values are represented at different rates in different grade levels has also been reported in many previous studies (Acar & Yaman Kasap, 2020; Meco & Costu, 2023; Turker et al., 2023; Yilmaz & Kiran, 2023).

Implications for Education

Based on the findings and results, it is recommended that chemistry textbooks be revised to include all types of values, especially “honesty” which is not included at all. In addition, for future textbooks, it should be ensured that authors include each type of value in the curriculum at a sufficient level. Additionally, it is recommended that both Türkiye's and all other countries' Ministries of Education place greater emphasis on the inclusion of values in textbooks during the evaluation process of candidate textbooks. When writing textbooks, efforts should be made to ensure that values are appropriately integrated into all units, not just in some units. Textbook authors might find it challenging to incorporate values into certain abstract chemistry topics and may be unsure how to deal with this issue. However, it is believed that even in units where the content is deemed unsuitable for value transmission, different types of values can be included in textbooks through reading passages that present the work and life stories of scientists in the field.

To contribute to values education in chemistry, researchers in this field should collaborate to create solutions on how values can be integrated into lessons and textbooks, and what activities can be conducted to address specific values in different units. Afterwards, a guidance document can be prepared for teachers and textbook writers that includes activities, stories, reading passages, anecdotes and similar teaching materials related to values that can be integrated into the content of each unit in chemistry.

In addition to the curriculum and textbooks, one of the important elements in values education is teachers. It is crucial for teachers, as the implementers of the curriculum, to

possess the necessary knowledge and experience to achieve the objectives of values education. Therefore, courses on values education should be included in teacher training faculties. These courses should also provide teacher candidates with sample activities and practices on how to integrate values into the specific units of their subject areas.

Based on the analysis of the extent to which values are included in chemistry textbooks in Türkiye, several recommendations can be made to extend the implications of this study to educational research and practice in other countries. First, we recommend that researchers in different educational contexts conduct similar analyses of science curricula to assess the integration of values, using this study as a methodological framework. Such comparative studies can enrich the global understanding of how values education is embedded in science education by illuminating international patterns and differences. Second, curriculum developers and textbook authors in other countries are encouraged to use our findings to develop or evaluate teaching materials by seeing how various values such as honesty, responsibility, etc. can be integrated with scientific content. Such an approach contributes to the holistic development of students and can align educational goals with ethical and social values. By highlighting the findings identified in the Turkish context, this study serves as a catalyst for broader discussions, encouraging educational communities in all countries to prioritize values education as an integral component of science curricula. These steps can ultimately contribute to educating students worldwide not only as competent scientists but also as morally and socially responsible individuals.

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Since this study did not collect data from human or animal subjects, it is not within the scope of studies requiring ethics committee approval. However, the principles of scientific research and publication ethics were followed in the preparation of the study.

Author Contribution Statement

Suat ÜNAL: Conceptualization, writing – review & editing, supervision

Ali İhsan BENZER: Literature review, data analysis, writing – review & editing

Medine Sultan ÖZKAN: Data collections, data analysis, writing – original draft preparation

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Appendix 1. Values and related attitudes and behaviours

Values	Indicators (attitudes and behaviours)
Benevolence	Being generous, cooperating, being compassionate, being hospitable, sharing...
Friendship	Altruism, trust, understanding, solidarity, loyalty, faithfulness, charity...
Honesty	Being clear and understandable, being truthful, being reliable, and keeping your word...
Justice	Fairness, equal treatment, equal sharing...
Love	Caring for family unity, making sacrifices, trusting, being compassionate, and being loyal...
Patience	Being determined, having perseverance, knowing how to wait.
Patriotism	Being hardworking, solidarity, obeying rules and laws, being loyal, being sensitive to historical and natural heritage, caring about the community...
Respect	Being humble, treating others, as you would like to be treated, and valuing the personalities of others, considering the position, characteristics, and situation of the interlocutor...
Responsibility	Being responsible for oneself, one's environment, one's homeland, one's family; keeping one's word, being consistent and reliable, taking the consequences of one's actions...
Self-Control	Controlling one's own behaviour, taking responsibility for one's own behaviour, having self-confidence, apologizing when necessary...

Appendix 2. Learning outcomes and the units in which values are emphasized the most in the chemistry curriculum

Grade Levels	Units	Learning Outcomes
Grade 9	Chemical Science	9.1.4.1. Students will be able to explain the occupational health and safety rules to be followed in chemistry laboratories. * It should be emphasized the necessity and importance of knowing the basic warning signs for occupational health and safety. 9.1.4.2. Students will be able to explain the effects of chemical substances on human health and the environment. * It should be emphasized the importance of Na, K, Fe, Ca, Mg, H₂O for human health and the environment. * It should be emphasized the harmful effects of Hg, Pb, CO₂, NO₂, SO₃, CO, Cl₂ on human health and the environment.
	Nature and Chemistry	9.5.1.1. Students will be able to explain the importance of water for beings. * It should be explained the importance of water resources and their conservation. 9.5.1.2. Students will be able to propose solutions for saving water and conserving water resources. * It should be emphasized that using water economically is the responsibility/duty of every citizen towards his/her country and the world. 9.5.2.1. Students will be able to explain the chemical pollutants that cause air, water and soil pollution. * It should be emphasized that nitrogen oxides, carbon dioxide and sulphur oxides are air pollutants. * It should be emphasized that plastics, detergents, organic liquids, heavy metals, batteries and industrial wastes are water and soil pollutants. 9.5.2.2. Students will be able to suggest solutions to reduce the effects of

		chemical pollutants that harm the environment. * It should be emphasized that the atmosphere is of vital importance for living things and for this reason, it is necessary to be sensitive to living things, the environment when choosing, and using consumer goods. * In order to raise awareness about environmental cleanliness, students are encouraged to develop campaign or activity suggestions with their groupmates. Students are reminded of the importance of distributing tasks and fulfilling everyone's responsibilities in achieving success in-group work.
Grade 10	Chemistry is All Around	10.4.1.1. Students will be able to explain the properties of cleaning agents. * It should be emphasized the benefits and harms of cleaning agents used in personal cleaning (shampoo, toothpaste, solid soap, liquid soap). 10.4.1.3. Students will be able to explain the contribution of recycling of polymer, paper, glass and metal materials to the national economy. 10.4.1.4. Students will be able to explain the harmful chemicals that cosmetic materials may contain. 10.4.1.5. Students will be able to explain the reasons for the use of drugs in different forms. * It should be mentioned the basic properties of drug forms (pills, syrups, injections, ointments) in the market. * It should be emphasized the damages of wrong and unnecessary drug use to human health, national economy and the environment. 10.4.2.1. Students will be able to explain the issues to be considered when choosing and consuming ready-to-eat foods. * It should be emphasized the importance of production and expiration dates on ready-to-eat food labels. * It should be mentioned the effects of the use of preservatives, colorants and artificial sweeteners on health. 10.4.2.2. Students will be able to classify edible oil types. * It should be emphasized the effects of misuse of edible oils on health.
	Acids, Bases and Salts	10.3.2.2. Students will be able to explain the important reactions of acids and bases in terms of daily life. * The dangers of concentrated sulphuric acid, phosphoric acid and acetic acid are emphasized due to their ability to absorb moisture and release heat while dissolving. 10.3.3.3.1. Students will be able to explain the benefits and harms of acids and bases * It should be mentioned the formation of acid rain and its effects on the environment and historical artefacts. * The effects of lime and caustic on oil, hair and skin are explained through experiments. 10.3.3.3.2. Students will be able to explain the health and safety precautions to be taken when working with acids and bases. * It should be given examples of household chemicals that are inconvenient to mix with each other (bleach and salt spirit). * It should be drawn attention to safety warnings on acid and base packages. * It should be emphasized the risks of excessive use of cleaning materials and sink openers in terms of health, environment and installation. * It should be emphasized the issues to be considered in the selection of

Grade 11	Gases	methods and materials to remove calcification on utensils and rust on metal objects.
		11.2.3.1. Students will be able to explain gas behavior by using kinetic theory
		*A diffusion experiment is conducted and explained utilizing information technologies such as animation, simulation, video, etc. It is reminded that safety warnings should be paid attention during the experiment.
Grade 12	Speed in Chemical Reactions	11.2.4.1. Students will be able to explain the partial pressures of gas mixtures with examples from daily life.
		11.5.2.1. Students will be able to explain the factors affecting the reaction rate.
		* In the lesson, a short biography of Oktay Sinanoğlu, a Turkish-American scientist who is the youngest professor in the world, and a reading passage introducing his studies on reaction mechanisms are given.
Grade 12	Energy Resources	12.4.1.1. Students will be able suggest solutions to reduce the harmful effects of fossil fuels on the environment.
		* It should be emphasized the damages of consuming and wasting fossil fuels unconsciously to the individual, society and the environment.
		12.4.2.1. Students will be able recognize alternative energy sources.
	Chemistry and Electricity	* It should be emphasized the importance of obtaining hydrogen from boron mineral for the development of our country.
		12.4.2.2. Students will be able evaluate the use of nuclear energy in terms of science, society, technology, environment and economy.
		12.4.3.1. Students will be able explain the importance of sustainable life and development for society and the environment by associating it with chemistry.
		* It should be mentioned the effects of energy, polymer, paper and metal sectors on sustainable life.
		12.1.4.1. Students will be able explain the voltage and lifetime of galvanic batteries under standard conditions by giving examples.
		12.1.4.2. Students will be able explain the importance of lithium ion batteries by associating them with their usage areas.
		* Students are encouraged to prepare a poster explaining lithium ion batteries and their current usage areas and present it in the classroom.
		12.1.6.1. Students will be able explain the electrochemical basis of corrosion prevention methods.