

Abstract. *Scholars as exemplars and their linked eponyms play a significant role in education. Since the discovery of the periodic law in 1869, perceptions of Mendeleev and his eponyms may have shifted. With the aim of assessing the historical and current portrayal of Mendeleev and his eponyms in chemistry textbooks and on the Internet, content analysis of textbooks, including Soviet and contemporary Russian (11) and Ukrainian (16), was conducted. Additionally, an Internet search in 7 languages was conducted to assess the prevalence of Mendeleevian eponyms online. Primary Mendeleevian eponyms are predominantly utilized in the Russian segment of the Internet. While Mendeleev's portrayal held significance in mid-20th-century Soviet chemistry textbooks, his presence has dwindled in current Russian and Ukrainian textbooks. This decline is attributed to the obsolescence of associated chemical realities, the disputed priority of Mendeleev, and an ambiguous attitude towards him. The implications of this decline include loss of historical context, reduced memorization aids, impact on critical thinking, disruption of continuity, and reduced humanism in education. The research underscores the importance of a balanced and inclusive approach to science education, recognizing contributions from scientists of diverse backgrounds and perspectives, and highlights the interconnected nature of science education and international relations.*

Keywords: *chemistry textbook, content analysis, eponym, Mendeleev, periodic system*

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MENDELEEV'S PORTRAYAL AND MENDELEEVIAN EPONYMS IN CHEMICAL EDUCATION: SIC TRANSIT GLORIA MUNDI

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Introduction

Education includes not only the transmission and acquisition of knowledge but also the cultivation of values among students, employing a diverse array of methodologies to achieve this objective. Among the various pedagogical approaches utilized, one of the most impactful is the use of positive exemplars. This method aims to furnish students with models of conduct, behavior, and lifestyle to emulate, thereby actively influencing the development of their consciousness, emotions, and beliefs.

In educational settings, considerable emphasis is often placed on the exemplars set by individuals within the immediate social environment of students, including parents, educators, and peers. However, it is imperative to recognize that the exemplars portrayed by characters in literature, cinema, and historical and political contexts also wield significant educational influence. These diverse exemplars serve as powerful vehicles for instilling values and shaping the moral and ethical compass of students, enriching their educational experience, and fostering holistic development.

In natural science education, positive exemplars encompass eminent scientists, many of whom are immortalized through eponyms, or named items. Notable instances include the Ptolemaic system, Grignard reagent, Graham salt, Baeyer–Villiger oxidation, Hoffman reaction, Allihn condenser, Claisen adapter, Williams–Landell–Ferry equation, Fourier transformation, Volt, Newton, and Pascal (the last three being physical units), as well as Lavoisier—the father of modern chemistry, Friedrich Wöhler—the father of organic chemistry, and Herbart—the father of scientific pedagogy, etc. In the classroom, eponyms serve as convenient shortcuts that enable teachers to seamlessly transition from explaining the subject's content to captivating narratives about scientists. By presenting these personalities as exemplars to emulate, educators make learning more educative, thus incorporating the principles of humanization and historicism into education (Slabin, 2017b).



Perhaps, D. I. Mendeleev was the most frequently cited exemplar in Soviet and East European chemical education, and he continues to hold this position in post-Soviet chemical education. *Mendeleev periodic table*, *Mendeleev periodic system*, and *Mendeleev periodic law* remain the most commonly used eponyms; in this publication, they are referred to as primary. According to Lagerkvist (2012, p. 112), "Today it goes without saying that the periodic law is perhaps the most decisive progress ever made in theoretical chemistry". Chrzanowski et al. (2017, p. 64) consider the periodic table of elements as „the foundation of modern chemistry from both the researcher's and the teacher's viewpoint.“ In the context of the history of the periodic law, many students have probably heard about Newland's octaves and Döbereiner's triads, but nobody in the Russian academic environment doubts the fact that the periodic law was "discovered by D. I. Mendeleev in 1969" (the words under the scientist's portrait in the common school version of the periodic table). In the professional chemical jargon spoken by instructors and teachers, as well as by students, the abbreviation "MPT" unambiguously stands for "Mendeleev periodic table."

A lot has changed over 150 years since the discovery of the periodic law in 1869. The events that took place have affected the international image of Russia, Russian science, culture, and Russian figures, both present and historical. Consequently, the perception of Mendeleev as a chemist and statesman, as well as attitudes toward him and his eponyms, might have evolved not only within Russia but also in Europe and globally.

Research Focus

Eponyms are researched on through various disciplinary lenses, including linguistics (Akhter, 2013; Kakzanova, 2015), bibliometry and scientometry (Becker et al., 2021; Cabanac, 2014), history (Lustig et al., 1998), ethics (Crease, 2023), philosophy (Bestor, 1978), sociology (Merton, 1957), and cultural studies (Qasim, 2023). Additionally, research delves into eponyms in medicine and education, mostly medical education. Cogan (1978), Felts (1999), Govindarajan et al. (1993), Gabovich and Kuznetsov (2024), Ma and Chung (2012), Trüeb (2018) and others have underscored the pedagogical, particularly didactic, significance of eponyms, their role in providing historical context, serving as memorization aids, strengthening critical thinking, and ensuring continuity and humanism in education. Medicine, perhaps, harbors more eponyms than any other field of knowledge; this is why discussions within the medical community revolve around whether to continue utilizing them, prompting considerations grounded in various rationales (Slabin, 2023d).

In recent years, attempts have been made to explain the linguistic stability and longevity of eponyms, drawing parallels from chemistry (Slabin, 2017b, 2022). The significance of eponyms in chemical education has been underscored, with a particular emphasis on the principles of historicism and humanism, which are often enshrined in educational policies across many nations (Slabin & Krasitski, 2017). Furthermore, investigations into college students' knowledge of eponyms and their attitudes toward them have been conducted (Slabin, 2017a, 2019b, 2019c), revealing that while knowledge of these terms is often non-reflexive, attitudes toward them tend to be uncertain. Additionally, the impact of various factors, including academic ethnocentrism, on the fate of specific eponyms has been assessed (Slabin, 2017c, 2023c).

One study involved compiling a dictionary of chemical eponyms, a review of 106 chemistry textbooks used in secondary schools and universities across English, Belarusian, Latvian, and Russian languages yielded the identification of 1642 eponyms (Slabin, 1995). These encompassed named acids, adapters, devices, bases, catalysts, capacitors, constants, elements, equations, filters, flasks, formulas, funnels, intermediates, laws, principles, projections, pumps, reactions, rearrangements, salts, plugs, theorems, theories, vessels, and more. Among the identified eponyms, Mendeleevian were also present.

Mendeleev's biography and his scientific legacy have been exhaustively studied. In recent years, Mainz (2018) has described the historical role of Mendeleev in developing chemistry textbooks for Russia. Chrzanowski et al. (2017) have studied representations of the periodic table of elements in Polish chemistry textbooks, and Akaygun and Arkun (2022) have completed the same task for Turkish chemistry textbooks. However, none of these studies has focused on Mendeleevian eponyms. While Chrzanowski et al. mentioned "Mendeleev's table" one time (as a keyword) (p. 57), Akaygun and Arkun gave credit to Mendeleev one time in the introduction (p. 1126) and subsequently called neither "Mendeleev periodic system" nor "Mendeleev periodic table."

Mendeleevian eponyms, however, have rarely been the focus of educational research. Considering the changes after the discovery of the periodic law in 1869, a reassessment of both Mendeleev's personality and his eponyms would be useful in the context of present-day reality.

Research Aim and Research Questions

This study aimed to assess the historical and current portrayal of Mendeleev (portrait and biography) and Mendeleevian eponyms in chemistry textbooks and on the Internet. This aim implied four research questions:

- RQ1: What Mendeleevian eponyms have ever existed and which of them remain in active use in life, in chemistry, and in chemical education?
- RQ2: What is the popularity of the primary Mendeleevian eponyms, "Mendeleev periodic system" and "Mendeleev periodic table," in various languages and in historical retrospective?
- RQ3: Are there changes in the popularity of Mendeleev and his eponyms in chemistry textbooks used in the former USSR, today's Russia, and today's Ukraine?
- RQ4: What are the reasons for these changes (if any) and what are their implications for chemical education?

Research Methodology*General Background*

Eponyms occur in both written texts and verbal communication. However, teachers consult chemistry textbooks while preparing lesson materials, as do students when studying for exams or working on assignments. Both educators and students rely on textbooks and frequently search for additional information on the internet. Consequently, science education has consistently emphasized the analysis of books and online resources, and the current study follows this trend.

Content analysis has been employed with a focus on specific aspects and topics in a number of chemistry textbooks:

- history, bibliography, and typography (Wojdon, 2018; Zubko, 2016)
- chemical principles (Clericuzio, 2006)
- didactic unit atomic models (Novais & Bedin, 2023)
- Brønsted-Lowry acid-base theory (Kim et al., 2017)
- included student activities (Aldahmash & Omar, 2021)
- Le Châtelier's principle (Quílez, 2021)
- nature of science (Abd-El-Khalick et al., 2008; Zarei & Hossein, 2023; Zhu & Tang, 2023)
- types of chemical reactions (Aydin et al., 2014)
- didactic capacity (Karásková et al., 2019)
- chemical representations (Demirdöğen, 2017; Akaygun & Arkun, 2022), etc.

Some of these studies encompassed textbooks in languages other than English (from Brazil, China, Iran, Korea, Poland, Saudi Arabia, Ukraine, etc.), and some entailed juxtaposing textbooks from diverse countries: France vs. Germany (Clericuzio, 2006), Turkey vs. India vs. USA (Aydin et al., 2014), Czech Republic vs. Russia (Karásková et al., 2019).

Content analysis is also applied to web-based content; the advantages and disadvantages of this application were discussed (Kim & Kuljis, 2010). Furthermore, a critical evaluation of the number of results was conducted, and the credibility and reliability of the sources found through a search engine, such as Google Search, were also examined (Ham, 2019). A method exists for extracting and quantifying eponyms in full-text articles (Cabanac, 2014), but there was no necessity to employ it since the focus was exclusively on Mendeleevian eponyms and not the entire spectrum of eponyms.

Hence, a content analysis of various media, including printed books, textbooks, and online sources, has been conducted to examine Mendeleev's presence, identify Mendeleevian eponyms, and assess their changes over a century. The research question guiding this method was whether there are differences in mentioning three primary Mendeleevian eponyms (Mendeleev periodic table, Mendeleev periodic system, and Mendeleev periodic law), the quantity and size of Mendeleev's portraits, and the volume of Mendeleev's biography in Soviet, recent and current Russian, and Ukrainian chemistry textbooks, retrospectively spanning 1924–2024.

Sample Selection

This study employed a non-probabilistic, non-random selection through purposive sampling, applying specific criteria to ensure representability. The selected textbooks had to be: (a) officially approved and widely used, (b) designed for 8th grade, as this is the grade when students become acquainted with the periodic law, periodic system, associated Mendeleevian eponyms, and Mendeleev's biography, (c) published, if possible, after equal or close periods covering one hundred years, (d) developed, if possible, by the same authors or author teams to track changes over years (decades) and identify trends in Mendeleev's presence and Mendeleevian eponyms while maintaining the same authoring style, and (e) published in Russia, the country for which Mendeleev worked, and in another country for comparison.

In the USSR, the unification policy impacted educational book publishing, resulting in a single standardized textbook for each subject used in translated versions across all Soviet republics (Wojdon, 2018, p. 181; Zubko, 2016, p. 47). Following the collapse of the USSR until 1994, Ukrainian schools utilized Russian chemistry textbooks by G. Rudzitis and F. Feldman, translated into Ukrainian (Zubko, p. 147). It took over a decade for Ukrainian chemistry textbooks to establish their own didactic tradition. Additionally, owing to the imposition of martial law, many textbooks in Ukraine were not published in 2022, and in 2023, textbooks for senior students were once again excluded from publishing plans. Due to these circumstances, this study focuses on Ukrainian chemistry textbooks from the period 2008–2021.

With regards to the above criteria, the following books were selected: (a) 8 Soviet chemistry textbooks (1924–1991), (b) 3 current and recent Russian chemistry textbooks (1991–2024), and (c) 16 current and recent Ukrainian chemistry textbooks (2008–2021).

The following units of analysis were specified: (a) eponym "Mendeleev periodic system," (b) eponym "Mendeleev periodic table," (c) eponym "Mendeleev periodic law," (d) Mendeleev's scientific predecessors and competitors, (e) Mendeleev's biography, and (f) Mendeleev's portrait(s). Using the terminology of Demirdöğen (2017), these portraits were visual representations, categorized as "scientist" (p. 496).

This study also employed a convenience sampling (106 chemistry books) for finding more eponyms in addition to the three well-known, primary Mendeleevian eponyms.

This study did not involve the sampling of online sources. Instead, the entire Internet served as the object for searching Mendeleevian eponyms.

Instrument and Procedures

For the chemistry textbooks, once the content facet was defined, a simple evaluating rubric was formulated as follows:

- "+" as presence of primary Mendeleevian eponyms (even a single case per textbook), "—" as their absence,
- names of Mendeleev's scientific predecessors and competitors (if any), "—" as their absence,
- volume of Mendeleev's biography (in pages), "—" as absence of the biography, and
- size of Mendeleev's portraits in Soviet and Russian chemistry textbooks (in fractions of page area), quantity of portraits in Ukrainian textbooks, "—" as absence of the portrait.

The selected textbooks were manually examined for the designated units of analysis, and the data were documented.

For the online sources, an advanced Google search was conducted for Mendeleevian eponyms to compare their prevalence in different languages. For the primary eponyms, the selected languages included: (a) English, being one of the most frequently used in science, (b) German, one of the primary languages in chemical literature, (c) Russian, the language of the country where Mendeleev worked, (d) Polish, the language of a former Soviet bloc country where Russian-Soviet science was also promoted, albeit with less ideological pressure (Wojdon, 2018), (e) Ukrainian, (f) Latvian, and (g) Belarusian, representing languages from the former USSR where Mendeleev's scientific achievements were popularized. For the non-primary but chemistry-related Mendeleevian eponyms the languages were English and Russian.

Table 1 shows parallel search queries for versions of the two primary and most popular eponyms "Mendeleev periodic table" and "Mendeleev periodic system," less common eponym "Mendeleev—the father of the periodic system," and "unnamed" periodic table (system), i.e., without mentioning the discoverer's name.

Table 1
Advanced Google Search Queries for Mendeleevian Eponyms

N	Search query
	In English: ^a
1.	<ul style="list-style-type: none"> – "Table of Mendeleev", "Mendeleev table", "Mendeleev periodic table"; – "System of Mendeleev", "Mendeleev system", "Mendeleev periodic system"; – "Chart of Mendeleev", "Mendeleev chart", "Mendeleev periodic chart"; – "Periodic table", "Periodic system", "Periodic chart" (without named after Mendeleev); – "Mendeleev", "father of the periodic table", "father of the periodic system".
	In German:
2.	<ul style="list-style-type: none"> – "Mendelejew-Tabelle", "Periodentabelle nach Mendelejew", "Periodentabelle der Elemente nach Mendelejew", "Periodentabelle der chemischen Elemente nach Mendelejew" – "Mendelejew-System", "Periodensystem nach Mendelejew", "Periodensystem der Elemente nach Mendelejew", "Periodensystem der chemischen Elemente nach Mendelejew" – "Periodentabelle", "Periodensystem" (without name "Mendelejew"); – "Mendelejew", "Vater des Periodentabelle", "Vater des Periodensystems"
	In Russian: ^b
3.	<ul style="list-style-type: none"> – «Таблица Менделеева», «Периодическая таблица Менделеева», «Периодическая таблица элементов Менделеева», «Периодическая таблица химических элементов Менделеева»; – «Система Менделеева», «Периодическая система Менделеева», «Периодическая система элементов Менделеева», «Периодическая система химических элементов Менделеева»; – «Периодическая система», «Периодическая таблица» (without name "Менделеева"); – "Менделеев", "отец периодической таблицы", "отец периодической системы".
	In Polish: ^c
4.	<ul style="list-style-type: none"> – "Tablica Mendelejewa", "Tablica okresowa Mendelejewa", "Tablica okresowa pierwiastków Mendelejewa", "Tablica okresowa pierwiastków chemicznych Mendelejewa"; – "Układ Mendelejewa", "Układ okresowy Mendelejewa", "Układ okresowy pierwiastków Mendelejewa", "Układ okresowy pierwiastków chemicznych Mendelejewa"; – "Tablica okresowa", "Układ okresowy" (without name "Mendelejewa"); – "Mendelejew", "ojciec tablicy okresowej", "ojciec układu okresowego".
	In Ukrainian:
5.	<ul style="list-style-type: none"> – "Таблиця Менделєєва", "Періодична таблиця Менделєєва", "Періодична таблиця елементів Менделєєва", "Періодична таблиця хімічних елементів Менделєєва"; – «Система Менделєєва», «Періодична система Менделєєва», «Періодична система елементів Менделєєва», «Періодична система хімічних елементів Менделєєва»; – «Періодична таблиця», «Періодична система» (without name "Менделєєва"); – "Менделєєв", "батько періодичної таблиці", "батько періодичної системи".
	In Latvian:
6.	<ul style="list-style-type: none"> – "Mendelejeva tabula", "Mendelejeva periodiskā tabula", "Mendelejeva elementu periodiskā tabula", "Mendelejeva ķīmisko elementu periodiskā tabula"; – "Mendelejeva sistēma", "Mendelejeva periodiskā sistēma", "Mendelejeva elementu periodiskā sistēma", "Mendelejeva ķīmisko elementu periodiskā sistēma"; – "Periodiskā tabula", "Periodiskā sistēma" (without name "Mendelejeva"); – "Mendelejevs", "periodiskās tabulas tēvs", "periodiskās sistēmas tēvs".
	In Belarusian:
7.	<ul style="list-style-type: none"> – "Табліца Мендзялеева", "Перыядычная табліца Мендзялеева", "Перыядычная табліца элементаў Мендзялеева", "Перыядычная табліца хімічных элементаў Мендзялеева"; – "Сістэма Мендзялеева", "Перыядычная сістэма Мендзялеева", "Перыядычная сістэма элементаў Мендзялеева", "Перыядычная сістэма хімічных элементаў Мендзялеева"; – "Перыядычная табліца", "Перыядычная сістэма" (without name "Мендзялеева"); – "Мендзялееў", "бацька перыядычнай табліцы", "бацька перыядычнай сістэмы".

Notes. ^aThe author agrees with Akhter (2013) and other researchers that eponyms in English should be written without an apostrophe (it is not possessive case). However, since in reality there are forms with and without an apostrophe, both queries were included in Google advanced search ("Mendeleev table" and "Mendeleev's table"), as well as queries with the transliteration "Mendelejev".

^bFor Russian, Belarusian, Polish and Ukrainian languages, advanced Google search was performed twice: with Mendeleev's initials (D. I.) and without them. For English, Latvian, and German languages the search was carried out once. The different approach is explained by the difference in word order in these languages.

^cFor Polish language Google search included the synonyms "tablica" and "tabela".



The number of Google search results is known to lack sufficient credibility, reliability, and reproducibility due to their susceptibility to various variables, dependence on fluctuations in the Internet's operation, reliance on the user's Google profile (including their previous search history), and changes over time. To address these issues, a Google search was conducted using a freshly installed browser, Google Chrome, on a newly set MacBook Pro over a continuous 4-hour period. Before this search, all cookie files were cleared, and no one was signed into any Google account. It's important to note that this Google search was an approximate estimation and was complemented with a more rigorous content analysis of chemistry textbooks, as described above.

In the pilot study of Mendeleevian eponyms, the initially obtained data were corrected by dividing by the number of native speakers and multiplying by 10,000, i.e., recalculated by the number of webpages per 10,000 native speakers (Slabin, 2023c). Later, such clarification was considered insignificant for identifying a trend. In this study, only the number of webpages in specific languages was recorded.

Data Analysis

The obtained data were used for: (a) charting (units of analysis in textbooks vs. time in 2D-line chart with markers, numbers of Google search results vs. languages in 100% stacked 2D-column chart), (b) identifying patterns (peaks of popularity) and trends (lately a decline), and (c) comparison (Soviet/Russian chemistry textbooks vs. Ukrainian textbooks, Russian websites vs. websites in other languages).

Research Results

Found Mendeleevian Eponyms

It seems obvious that a great scientist will leave behind more than one eponym, and that these eponyms will be well known. Given Mendeleev's significant scientific legacy, which extends beyond the periodic law, one could anticipate a large number of linguistic derivatives associated with him.

It was found that Mendeleevian eponyms do indeed exist in significant numbers. Among them are toponyms: astionym *Mendeleevsk* (city), komonym *Mendelevo* (village), metro station *Mendeleevskaya* in Moscow, ergonym – airport named after Mendeleev, some odonyms. All these objects are located in Russia. Other toponyms include *Mendeleev glaciers* in Kyrgyzstan and Antarctica, oceanonym *Mendeleev ridge* on the Arctic Sea bottom, oronyms *Mendeleev volcano* and *Mendeleev crater* on the Moon (the latter is also known as *Catena Mendeleev*), cosmonym *2769 asteroid Mendeleev*, etc. Machinonyms are represented by the Airbus A321 *Dmitri Mendeleev* in Aeroflot, Russian Airlines, and a research ship with the same name. In addition, there are university, institute, academy, college, and library named after Mendeleev.

Almost two dozen eponyms relate to chemistry:

- | | |
|---|--|
| 1. <i>Mendeleev</i> periodic system [of the chemical elements]. | 11. <i>Mendeleev</i> –Clapeyron equation. |
| 2. <i>Mendeleev</i> periodic table [of the chemical elements]. | 12. <i>Mendeleev</i> pycnometer. |
| 3. <i>Mendeleev</i> [periodic] law. | 13. <i>Mendeleev</i> –Geissler (Geißler) pycnometer. |
| 4. <i>Mendeleev</i> the father of the periodic table. | 14. <i>Mendeleev</i> gunpowder. |
| 5. <i>Mendeleevium</i> (Md), a chemical element. | 15. <i>Mendeleevian</i> vodka. |
| 6. <i>Mendeleev</i> hydrate theory. | 16. Oil refinery named after <i>Mendeleev</i> (Yaroslavl, Russia). |
| 7. <i>Mendeleev</i> scales. | 17. Russian Chemical Society named after <i>Mendeleev</i> . |
| 8. <i>Mendeleev</i> weighing method. | 18. Scientific journal " <i>Mendeleev Communications</i> " (Russia). |
| 9. <i>Mendeleev</i> altimeter (differential barometer). | 19. " <i>Mendeleevian Readings</i> ", a conference held in Belarus, Russia, and Ukraine. |
| 10. <i>Mendeleevian</i> putty. | |

A special case is the Mendeleevian eponym used to characterize Academician N. I. Vavilov, an outstanding Soviet agronomist and geneticist. It is "Mendeleev of Biology" (Aronova, 2021, p. 65).

Mendeleev's Portrayal and His Primary Eponyms in Chemistry Textbooks

Analysis of Soviet and Russian textbooks made it possible to trace the history of Mendeleevian eponyms and the attention paid to the scientist and his predecessors over the past 100 years (Table 2).

Table 2*Mendeleev's Portrayal and His Primary Eponyms in Soviet and Current Russian Chemistry Textbooks*

Textbook	The primary Mendeleevian eponyms			Portrait of Mendeleev (page area)	Biography of Mendeleev (number of pages)	Predecessors and scientific competitors of Mendeleeva
	"Mendeleev periodic system"	"Mendeleev periodic table"	"Mendeleev law"			
Kablukov (1924)	+	+	–	–	–	Meyer
Pavlov and Semenchenko (1934)	+	–	–	–	–	Döbereiner, Newlands, Thomsen
Verkhovsky (1940)	+	+	+	1/6	–	–
Levchenko et al. (1953)	+	+	+	1/2	2	–
Khodakov et al. (1960)	+	–	–	1	2	–
Khodakov et al. (1972)	+	–	+	1	1 1/2	–
Khodakov et al. (1979)	+	–	+	1	1 1/2	–
Rudzītis and Feldman (1985)	+	+	+	1/6	1	Döbereiner, Meyer, Newlands, Chancourtois
Rudzītis and Feldman (2011)	–	+	+	1/8	1	Döbereiner, Newlands, Meyer, Chancourtois, Odling
Rudzītis and Feldman (2016)	–	+	+	–	1/2	Döbereiner, Newlands, Meyer, Chancourtois, Odling
Rudzītis and Feldman (2022) ^b	–	+	+	–	–	Döbereiner, Newlands, Meyer, Chancourtois, Odling

Notes. ^aThe predecessors here are understood to be Newlands, Döbereiner, Chancourtois and Odling, and the competitor is Meyer. Moseley, although mentioned in some textbooks, improved the existing table and is neither a predecessor nor a competitor.

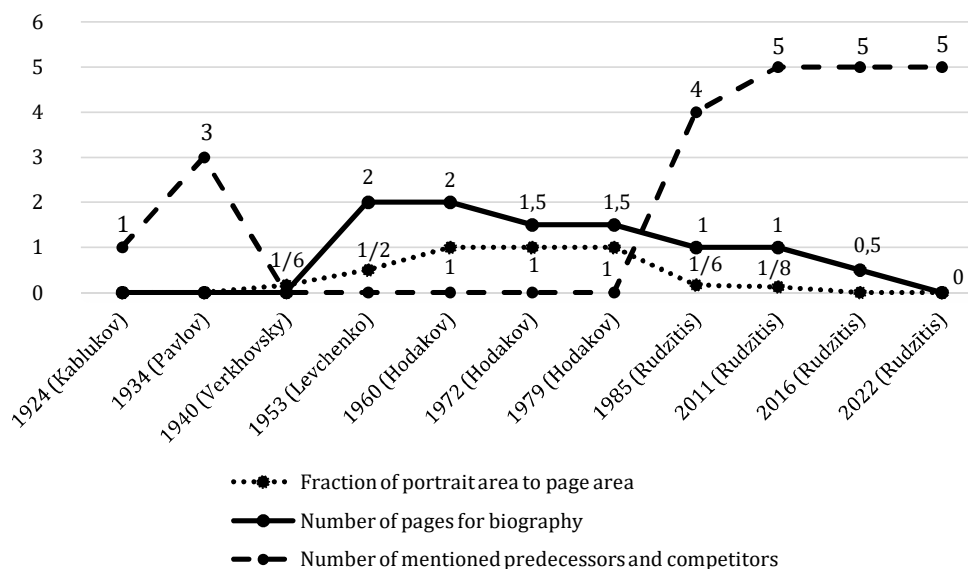
^bSince the last edition of this textbook, this table covers almost one century (1924–2024).

The analysis reveals three periods:

- **1924–1940: Silence.** During this period, there is a conspicuous absence of references to Mendeleev's periodic law, as well as the exclusion of his portrait and biography. The focus remains on the Mendeleev periodic system and table, along with mentions of his predecessors and scientific competitors, including Meyer, Döbereiner, Newlands, and Thomsen.
- **1940–1985: Growth and Bloom.** This era witnesses significant growth and prominence. The first mention of Mendeleev's periodic law appears, accompanied by the introduction of his portrait (1/6 page) in the 1940 textbook by Verkhovsky. The trend continues with the inclusion of Mendeleev's periodic system and table, the expansion of his portrait to 1/2 page, and the addition of a comprehensive 2-page biography in the 1953 textbook by Levchenko et al. Mendeleevian eponyms persist, and his portrait size expands, while extensive biographies continue. Noteworthy, there is a total absence of references to his predecessors and scientific competitors in chemistry textbooks until 1979.
- **1985–2024: Decline.** In this period, there is a noticeable decline in Mendeleev's representation. His portrait size shrinks from a full-page to 1/6 page, and his biography decreases from 1 1/2 pages to 1 page. The chemistry textbook by Rudzītis and Feldman in 1985 marks a turning point with the reappearance of Mendeleev's predecessors and scientific competitors – Döbereiner, Meyer, Newlands, and Chancourtois. The trend continues with further reductions in Mendeleev's portrait size (down to 1/8 page) and the introduction of a new predecessor, Odling, in the 2011 edition by Rudzītis and Feldman. The decline culminates in the complete disappearance of Mendeleev's portrait, biography, and the eponym "Mendeleev periodic system" in the 2022 edition by Rudzītis and Feldman. Indicatively, the 2016 textbook by Rudzītis and Feldman included the task "Using the Internet and additional literature, prepare a computer presentation on the topic 'The life and work of D. I. Mendeleev'; while the 2022 edition simplified it to only "Find the biography of D. I. Mendeleev on the Internet and read it".

Figure 1 illustrates the described trend.



Figure 1*Mendeleev's Portrayal in Soviet (1924–1991) and Current Russian (1991–2022) Chemistry Textbooks*

Analysis of Ukrainian textbooks made it possible to trace the history of Mendeleevian eponyms and attention to the scientist over the past decade and a half (Table 3).

Table 3*Mendeleev's Portrayal and His Primary Eponyms in Current Ukrainian Chemistry Textbooks*

Textbook	The primary Mendeleev eponyms		Portraits of Mendeleev	Biography of Mendeleeva	Predecessors and scientific competitors of Mendeleev
	"Mendeleev periodic table"	"Mendeleev periodic law"			
Burynska (2008)	+	+	8	4½ pages	Berzelius, Meyer
Burynska (2016)	+	+	1	¼ page	Berzelius, Meyer
Butenko (2016)	+	+	1	1/3 page	Lavoisier, Berzelius
Butenko (2021)	–	+	1	1/3 page	Lavoisier, Berzelius
Hrankina (2016)b	+	+	1	0	Richter, Döbereiner, Meyer, Newlands,
Hryhorovych (2021)	–	+	1	½ page	Döbereiner, Newlands, Meyer
Diachuk and Hladiuk (2016)	–	+	0	1 page	Berzelius, Döbereiner, Newlands, Meyer
Lashevskaya and Lashevskaya (2016)	+	+	3	2 pages	Lavoisier, Döbereiner, Newlands, Chancourtois, Meyer
Popel and Kryklya (2008)	+	+	3	3 pages	Lavoisier, Döbereiner, Newlands, Meyer
Popel and Kryklya (2016)	–	–	1	0	Lavoisier, Döbereiner, Newlands, Meyer
Popel and Kryklya (2021)	–	–	2	0	Lavoisier, Döbereiner, Newlands, Meyer



Textbook	The primary Mendeleev eponyms		Portraits of Mendeleev	Biography of Mendeleeva	Predecessors and scientific competitors of Mendeleev
	"Mendeleev periodic table"	"Mendeleev periodic law"			
Savchyn (2016)	–	+	1	1½ page	Lavoisier, Döbereiner, Newlands, Chancourtois, Meyer
Savchyn (2021)	–	+	0	1/3 page	Lavoisier, Döbereiner, Newlands, Chancourtois, Meyer
Yaroshenko (2008)	+	+	2	3 ² / ₃ page	Lavoisier, Döbereiner, Newlands, Meyer
Yaroshenko (2016)	+	+	2	2 ² / ₃ page	Lavoisier, Döbereiner, Newlands, Meyer
Yaroshenko (2021)	–	+	1	1 ¹ / ₃ page	Lavoisier, Döbereiner, Newlands, Meyer

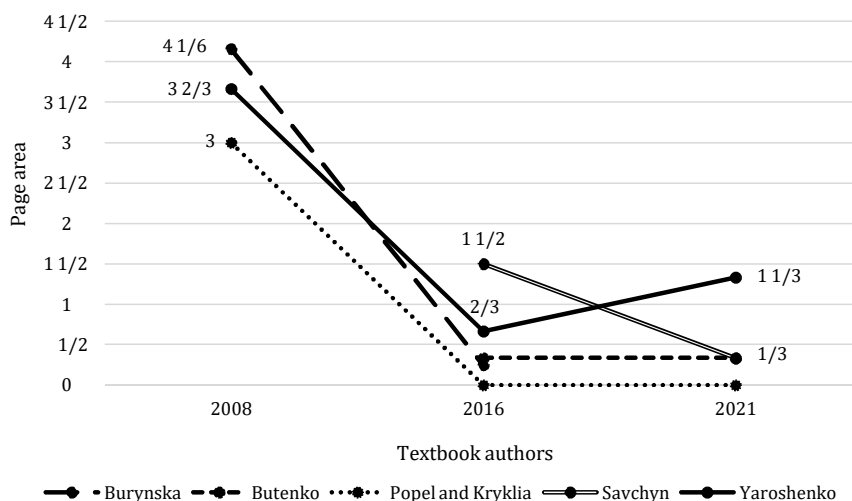
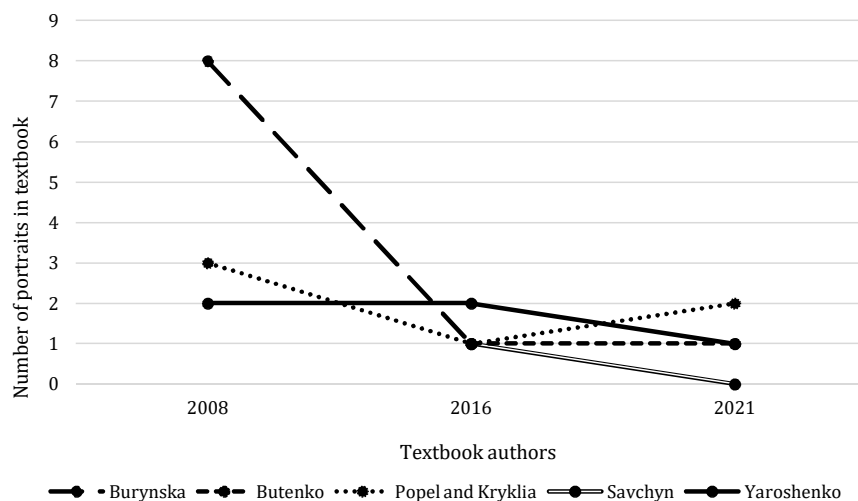
Notes: ^aIncluding Mendeleev's portraits, if any were a part of biography.

^bExcept this author's textbook, no Ukrainian textbook employs "periodic table", that is why the corresponding column was excluded.

In the Ukrainian textbooks reviewed, similar to Russian ones, Mendeleev periodic system (table) and law are denoted with the initials "D. I." No other chemical eponym has been granted such an honor. It is challenging to imagine A. W. von Hoffmann reaction or J. G. K. T. Kjeldahl method. This practice reflects a profound level of respect. In the former USSR, mentioning the names of notable individuals without a patronymic was discouraged, and referring to individuals as "Vladimir Lenin" or "Leonid Brezhnev" was considered disrespectful. Another approach to express respect was to address individuals by their first (given) name and patronymic. Here are some examples:

- "The outstanding Russian scientist Dmitry Ivanovich Mendeleev discovered in 1869 one of the fundamental laws of nature, the periodic law of chemical elements" (Butenko, 2016, p. 37).
- "Many attempts to classify elements were made by different scientists, but success was achieved by the great Russian scientist D. I. Mendeleev, who managed to combine all the elements into a single system of chemical elements" (Burynska, 2016, p. 22).
- "Thanks to the discovery of the periodic law, it was established that all elements are interconnected, obey a single law, and form a single system, which was rightly named after the scientist "the periodic system of chemical elements of D. I. Mendeleev" (Burynska, 2008, p. 25).
- "At his leisure, Dmitry Ivanovich loved to bind books" (Hryhorovych, 2021, p. 83).
- "In most European countries, as in Ukraine, the periodic system of chemical elements is called after Dmitry Ivanovich Mendeleev. In some countries, it is simply called the periodic system without any name. In the USA, the periodic system is called after Lothar Meyer" (Hryhorovych, 2021, p. 19).

Frequently, "D. I. Mendeleev periodic system" is initially introduced (for instance, as the title of a paragraph), and subsequently, referred to simply as the "periodic system" without mentioning the scientist's name. As evident from Table 3, there is a discernible trend in Ukrainian textbooks over the last decade and a half to diminish both the primary Mendeleevian eponyms and the inclusion of his portraits and biography. This trend becomes apparent when comparing publications from different years by the same authors (Figures 2 and 3).

Figure 2*Mendeleev's Biography in Current Ukrainian Chemistry Textbooks (2008–2021)***Figure 3***Mendeleev's Portrait in Current Ukrainian Chemistry Textbooks (2008–2021).*

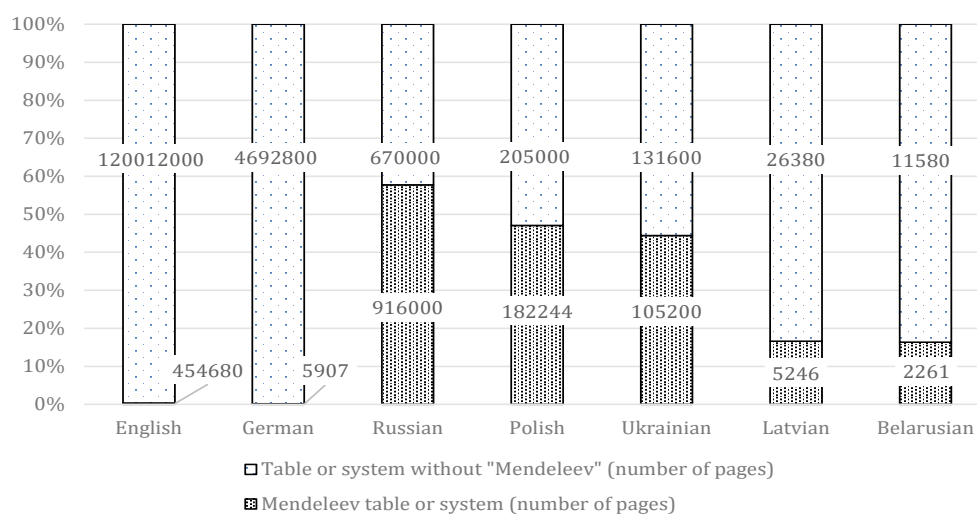
In Ukrainian textbooks, compared to Russian ones, portraits of Mendeleev are noted for greater diversity. Thus, in Burynska's textbook (2008) there are three painted portraits, two photographs, two postage stamps and a monument to Mendeleev in front of the chemical building of the Kyiv Polytechnic Institute. The textbook by Popel and Krykليا (2008) shows a photo of Mendeleev as a student, Mendeleev in a professor's robe, and Mendeleev in the last years of his life.

Mendeleevian Eponyms on the Internet

Advanced Google search confirmed that the primary Mendeleevian eponyms are found unevenly in different languages. As follows from Figure 4, the "Mendeleev periodic table" and "Mendeleev periodic system" prevail only on webpages in Russian, while webpages in other languages prefer the unnamed "periodic table" and "periodic system". The percentage of the primary Mendeleevian eponyms on webpages in English and German is quite insignificant.

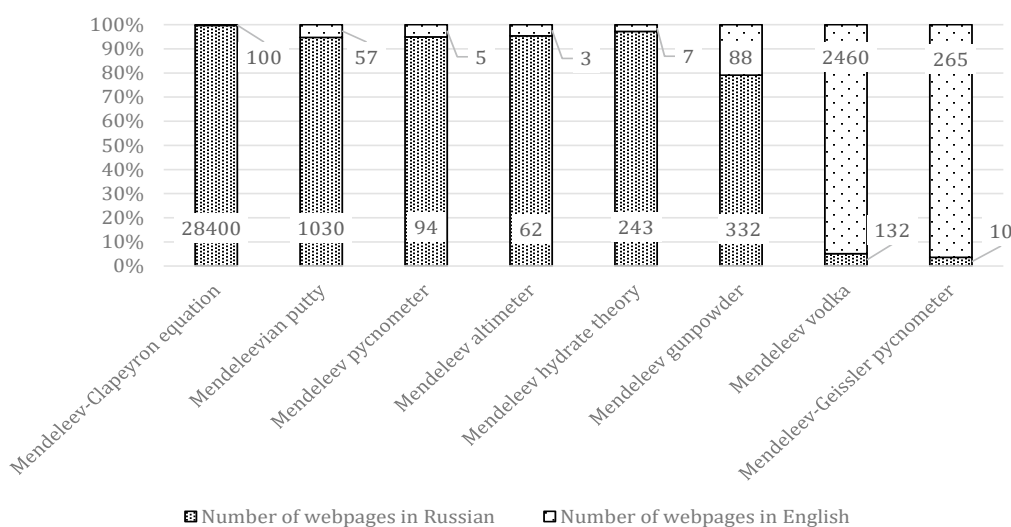


Figure 4
Primary Mendeleevian Eponyms on the Internet



In general, this fact was also confirmed for non-primary Mendeleevian eponyms, as observed in the percentage of webpages in Russian compared to those in English (Figure 5).

Figure 5
Non-Primary Mendeleevian Eponyms on the Internet



Note. Data for the "Mendeleev weighing method" (38.5% Russian vs. 61.5% English) were omitted from this chart after it became apparent that the webpages returned by Google were not related to the chemical eponym but rather to the history of Mendeleev defining atomic weights. This eponym in Russian refers to the widely utilized method for precise weighing in laboratory practice: weights equivalent to the maximum limit are added to one side of the scales, while a counterbalancing tare weight is placed on the other, asf.

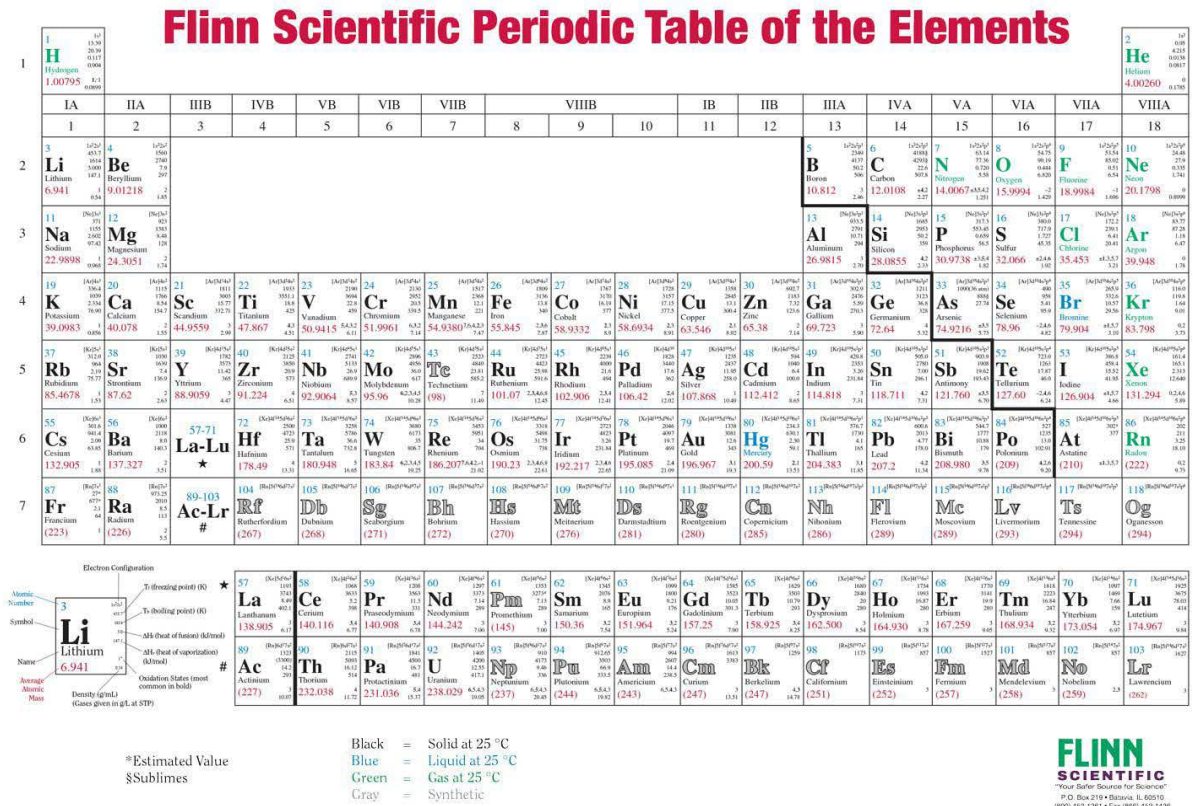
As follows from Figure 6, Mendeleev, as the "father of the periodic table", is found mainly on webpages in English and German.

Figure 6*Eponym "Mendeleev the Father of the Periodic Table (System)" on the Internet**Non-Mendeleev Periodic Tables*

Flinn (Figure 7) and Ross (Figure 8) periodic tables of chemical elements were identified. If Mendeleev's priority in the discovery of the periodic law and the construction of the periodic table is established, then these tables should be considered as potential instances of plagiarism (Slabin, 2019a). Teachers, instructors, and students at schools, colleges, and universities in the USA utilize these tables, finding them in classrooms, lecture halls, and laboratories as visual aids and handouts. The company's website states: "The Flinn Periodic Table Chart is a direct result of teacher feedback! We asked the best chemistry teachers for feedback and incorporated their suggestions into a new periodic table! You asked; we delivered!" The Ross Table is recommended as "the First Pedagogical Periodic Table Designed to be Learned!" Interestingly, Google Translate (apparently managed by Russian programmers) translates "The designed first pedagogical periodic table to be learned" as "The designed first pedagogical Mendeleev table to be learned." Both tables are protected by copyright owned by Flinn Scientific.



Figure 7
A Non-Mendelev Periodic Table



Note. From <https://www.flinnsci.com/products/chemistry/charts--posters/flinn-periodic-table-charts>. Copyright 2017 by Flinn Scientific, Inc.

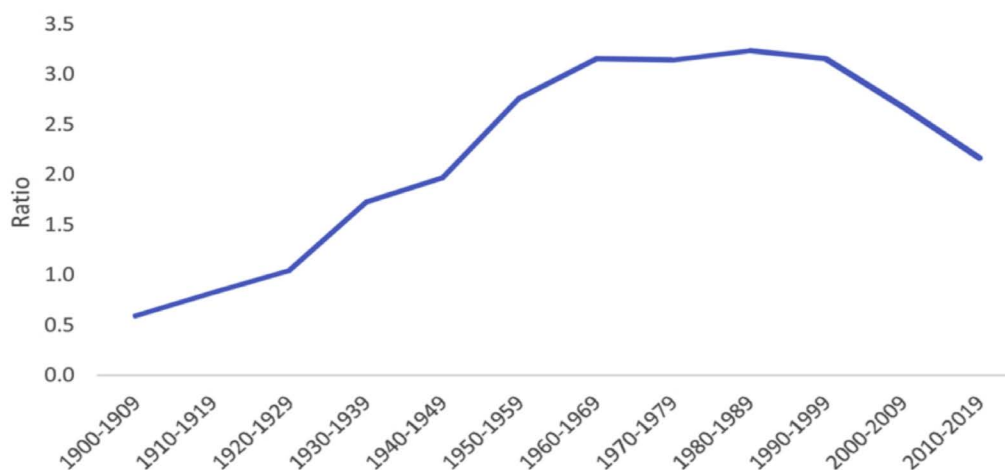
connection to chemistry as a science) on webpages in English can be attributed to the aggressive international advertising campaigns conducted by Russian alcohol-producing companies. This conclusion is supported by the analysis of the first page of Google search results.

One interesting observation is the prominence of Mendeleev as the 'father of the periodic system' on English and German webpages compared to Russian ones. This tendency of associating founders with paternal roles, seen in phrases like 'Founding Fathers of the United States' and 'Gründerväter für die Bundesrepublik Deutschland', may be more prevalent in English and German languages than in others included in the search. Another notable instance is the higher prevalence of the non-primary eponym 'Mendeleev-Geissler pycnometer' compared to 'Mendeleev pycnometer' on English webpages (96:4), whereas the opposite is observed on Russian webpages (5:95). This suggests that the international scientific community (at least its English-speaking part) acknowledges the shared priority of Geissler and Mendeleev in the invention of the pycnometer, rather than attributing sole priority to Mendeleev.

On the other hand, the inclusion of Mendeleev's portraits and biography in contemporary Russian and Ukrainian chemistry textbooks is diminishing, notwithstanding its zenith in mid-20th-century Soviet textbooks. Remarkably, these findings converge with the outcomes reported by Becker et al. (2021) in their investigation of eponyms within medical literature across the entirety of the 20th century and an additional 19 years (Figure 9).

Figure 9

Ratio of Eponym to Non-Eponym Use in 1900–2019



Note. From "Declining use of neurological eponyms in cases where a non-eponymous alternative exists," by C. J. Becker, M. McDermott, & Z. N. London, 2021, *Clinical Neurology and Neurosurgery*, 200, 106367, p. 3. (<https://doi.org/10.1016/j.clineuro.2020.106367>). Copyright 2020 by Elsevier B. V.

The chart illustrates an increase in eponym use during the early 20th century, reaching its peak in the 1950s and 1960s, followed by a plateau until the late 20th century, and a subsequent decrease in the early 21st century—researchers preferred non-eponymous terms. While Becker et al. (2021) examined numerous eponyms, and the present research specifically concentrated on Mendeleevian eponyms, the observed trend remains consistent—cf. Figure 1.

The trend demonstrates that eponyms, like any other phenomenon, follow a historical trajectory of emergence, peak, and decline. One should concur with Cogan (1978), whose work, "The rise and fall of eponyms," states, "Most eponyms, like most people, serve a useful purpose, for a time. During their life tenure they establish a coterie of friends, develop a sort of cultural identification, and, of course, are ever subject to critical evaluation. But their life span is finite" (p. 2202).

*Reasons for Low Popularity of Mendeleev and His Eponyms in 1920s
and Surge of Their Popularity in 1940–1991*

One reason for Mendeleev's low popularity in early Soviet textbooks may stem from the enduring underestimation of his achievements, a sentiment persisting from the Russian Empire. This sentiment is articulated by Volkovich

et al. (1957), who note that “the scientific merits of D. I. Mendeleev had not yet received due and public recognition, which was reflected in the elections to the Academy of Sciences in 1880 when D. I. Mendeleev was voted out, and the *mediocre* [emphasis added] chemist Beilstein was elected academician” (p. 7). Notably, the latter’s name is immortalized in the eponyms “Beilstein test” (a qualitative method for determining halogens, excluding fluorine, in organic substances by flame coloring) and the fundamental “Beilsteins Handbuch der organischen Chemie (Beilstein Handbook of Organic Chemistry).” Lagerqvist (2012) points out that Russian colleagues unsurprisingly did not nominate Mendeleev for the Nobel Prize, while foreign chemists did so three times but without success (p. 112).

Another reason for the absence of Mendeleev’s portrait, biography, periodic table, and periodic law from early Soviet textbooks could be the emphasis on utilitarian chemistry at that time and the Bolshevik authorities’ desire to replace traditional textbooks with *newspaper-textbooks*, *magazine-textbooks*, and *workbooks* (Zubko, 2016, p. 265). Teleshov (2013) writes, “there was a period of total denial of any study text” (p. 42). Indeed, such substitutes contained a minimum to no coverage of the theory and history of chemistry, including Mendeleev and his eponyms.

In seeking a reason for the surge in Mendeleev’s popularity in textbooks of 1940–1985, one might be tempted to speculate that Russian-Soviet chemists required the first half of the 20th century to fully recognize the paramount importance of Mendeleev’s discovery. One can assume that during this period, they began to feel a sense of guilt about underestimating their compatriot scientist and endeavored to rectify this by doing everything possible to compensate for the prior neglect. This explanation, however, would be overly idealistic, as intellectuals in the USSR lacked the autonomy to make decisions, especially those grounded in moral and ethics. A more plausible scenario is that the communist government mandated the glorification of domestic scientists, including Mendeleev. In his report, “Tasks of Soviet historians of chemistry in the fight against servility and sycophancy before foreign countries,” delivered at the First All-Union Meeting on the History of Russian Chemistry (1948), professor Figurovsky lamented:

For many decades in old Russia, the history of Russian science was dominated by foreigners. They consciously or unconsciously distorted specific facts and even entire periods in the development of science, covering them with bias and instilling in the Russian people the idea of the lack of independence of Russian science. Traces of the activities of such historians—falsifiers of science—are often evident in our time, manifested in exaggerated admiration for foreign authorities, in an uncritical approach to the assessment of individual facts and phenomena in science gleaned from foreign sources, in insufficient attention to the works of Russian scientists, and, finally, in the undeserved oblivion of the works and names of many illustrious Russian chemists. (Figurovsky, as cited in Arbutov, 1950, p. 85)

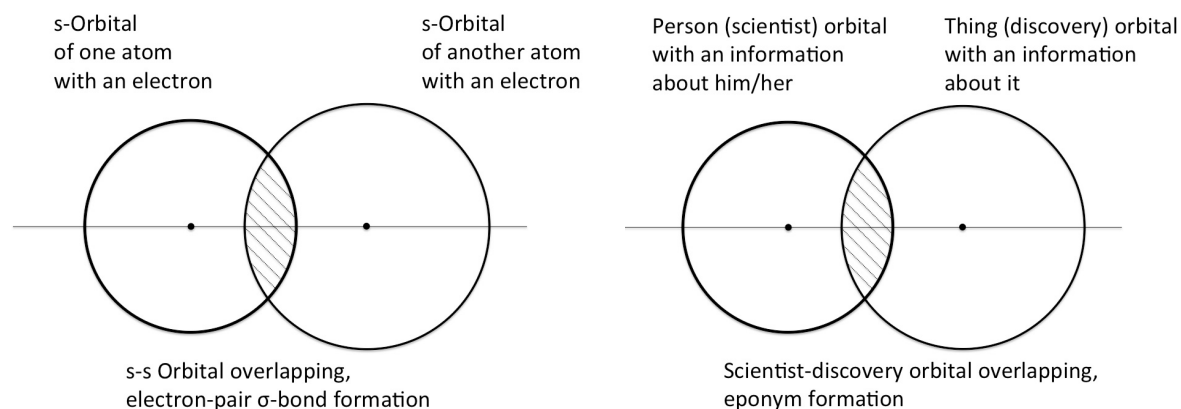
This argument is supported by Wojdon (2016) in her book “Textbooks as propaganda: Poland under Communist Rule, 1944–1989,” “We (...) read countless stories on the Soviet achievements related to all the disciplines of science and all spheres of life (...) The directives encouraged the broader propagation of the achievements of the Soviet science and art, supplementing patriotism with “internationalism” and proposed the inclusion of “the struggle for socialism”” (pp. 10, 25).

Szabolcsi (1989) is perfectly right, positing in his analysis of ethnocentrism in European education that in the late 19th century, each country considered it vital to reconstruct and overly accentuate the unique characteristics of its people, thus propelling its national excellence to the forefront. What are perhaps the most difficult to eliminate are the contradictions arising from a self-centered view; yet this is typical of most European textbooks (p. 150–152). Although Szabolcsi describes history textbooks in the mid-20th century, his findings underscore the alignment of the USSR regime’s decision to promote Russian/Soviet scientists, including Mendeleev, with prevailing trends of the time.

Reasons for the Decline of Popularity of Mendeleevian Eponyms Since 1985

As a starting point for finding reasons for the declining popularity of Mendeleevian eponyms, one can draw an analogy to the explanation of eponym stability with valent bond (VB) theory in chemistry (Figure 10).

Figure 10
Formation of an Eponym (Right) as a VB Metaphor of Chemical Bond (Left)



Note. From "Scientific eponym in educational universe," by U. Slabin, 2017, *Journal of Baltic Science Education*, 16(2), p. 145 (<https://doi.org/10.33225/jbse/17.16.144>). Copyright 2017 by SMC "Scientia Educológica" and Scientia Socialis.

This theory suggests that the strength of the bond between the scientist and their discovery, reflected in the overlap between their respective "orbitals" of information, determines the stability of the resultant eponym. Clearly, the waning stability of eponyms can be attributed to the weakening of this bond. As will be demonstrated, the first reason is linked to the discoveries themselves, the second to both the scientist (Mendeleev) and his discoveries, and the third solely to the scientist.

Obsolescence of Associated Chemical Realities

This reason appears objective and natural, exemplified by many cases in the history of science. E.g., advances in quantum mechanics and a more nuanced understanding of electron behavior led to a broader set of principles, diminishing the exclusive use of the *Bohr radius*. *Daltonism* fell out of favor as more accurate and nuanced classifications of color vision deficiencies emerged.

Watts' "Manual of Chemistry" (1883) provides a clear illustration of how chemical terminology can become obsolete over time. Among the 86 eponyms listed in this textbook (pp. 585–595), roughly one fifth (Argand lamp, Cavendish eudiometer, Cruickshank battery, pyrophorus of Homberg, Labarraque disinfecting fluid, fuming liquid of Libavius, etc.) are unfamiliar to today's college freshmen, unless they have a keen interest in the history of chemistry.

Even Mendeleevian eponyms have not escaped this fate. For example, the significance of Mendeleevian putty in laboratory practice has significantly diminished with the widespread adoption of taper glassware. Similarly, non-primary Mendeleevian eponyms have followed a trajectory akin to outdated Verkhovsky eponyms (Slabin, 2017c). Many of these terms have either faded into obscurity or are primarily found in Russian-language texts authored by Russian chemists, chemistry teachers, and lecturers.

Disputed Priority of Mendeleev

This reason aligns with Merton (1957), whose research on priority in scientific discovery generously lists disputes Newton vs. Hooke, Cavendish vs. Watt, Faraday vs. Wollaston, Galileo vs. as many as four competitors (physics), Newton vs. Leibniz, Hooke vs. Huygens (mathematics), Cavendish vs. Lavoisier (chemistry), etc. "Laplace, several of the Bernoullis, Legendre, Gauss, Cauchy were only a few of the giants among mathematicians embroiled in quarrels over priority" (pp. 635–636). Merton considers such conflicts to be a common, integral part of the social relations among scientists.

The questioned priority of Mendeleev in the discovery of the periodic law has hindered the widespread adoption of his primary eponyms—"Mendeleev periodic law," "Mendeleev Periodic system," and "Mendeleev periodic table." In 1882 the Royal Society of London *jointly* awarded Mendeleev and Meyer the Davy Medal for their



discovery of the periodic relations between the atomic weights. IUPAC does not offer a specific recommendation for the form of the periodic table, nor does it endorse any eponymic names.

While many scientists acknowledge Mendeleev's priority, a significant number of foreign chemists do not share this perspective. Scerri (2021) states:

Dmitri Mendeleev is typically credited with the discovery of the periodic table, but when he published his table, as many as 5 other authors in different countries had already published their own periodic tables, including one Lothar Meyer who had published several tables over a period of seven years. (...) Lothar Meyer's first tables were published in 1864, well before Mendeleev's now famous version of 1869. (...) What was Mendeleev doing in 1864 when Meyer published his first rudimentary periodic tables? It turns out he was still in the process of obtaining his doctorate and had not thought very much about classifying the elements as far as we know.

As this priority remains disputed, the existence of Flinn, Ross and other found non-Mendeleev periodic tables that unsettle Russian chemistry teachers, does not constitute plagiarism or copyright infringement. The priority has not been established, and the eponyms "Mendeleev periodic system" and "Mendeleev periodic table" are not registered anywhere as trademarks. It is also unlikely that ubiquitous ethnocentrism (Szabolcsi, 1989; Slabin, 2017c, 2023c) played a role—Flinn Scientific marketers did not name their tables after famous American chemists like Pauling and Seaborg. Instead, guided by market conditions and business strategies, they named the tables just to promote their products and enhance profits. Their trick lies in the ambiguity of the English expression "Flinn Scientific Periodic Table of the Elements," which can be understood as both "a table of [chemical] elements developed by Flinn Scientific" and "a scientific table of [chemical] elements discovered by Flinn."

Ambiguous Attitude Towards Mendeleev's Personality

The recognition of and attitude towards a scientist is shaped not only by their scientific accomplishments but also by their ethical, moral, and political views, as well as their statements and actions. Moreover, in certain instances, these aspects can impact the attribution of eponyms to a particular scientist. In recent decades, it has become increasingly prevalent. In their research on medical education, Becker et al. (2020) confirm that "the precipitous fall of these eponyms suggests that contemporary audiences are more likely to view the scientific accomplishments of an individual in the context of their personal and political life" (p. 3). They also provide examples:

The last two decades have seen the fall of the term Hallervorden-Spatz disease in favor of the non-eponymous term pantothenate kinase-associated neurodegeneration. This coincides with the public acknowledgement that Julius Hallervorden and Hugo Spatz were complicit in the study and use of brains acquired from a Nazi euthanasia program between 1939 and 1941. Other eponyms, such as Wegener's granulomatosis and Reiter's syndrome, have fallen out of favor for similar reasons (Zeidman & Pandey, 2012; Lefrak & Matteson, 2007, as cited in Becker et al., 2020, p. 3).

This reason looks realistic with further examples by Crease (2023):

- James Watson (eponym „Watson–Crick model“). The Nobel Prize laureate was forced to retire as chancellor of Cold Spring Harbor Laboratory (USA) for his controversial statements about race and intelligence, widely condemned as racist.
- Erwin Schrödinger (eponym „Schrödinger equation“). Schrödinger Lecture Theatre at Trinity College Dublin was renamed and restored to its previous title of Physics Lecture Theatre after reports of Schrödinger's sexual abuse of girls.
- Johannes Stark (eponym „Stark effect“). Calls have been made to rename the effect of splitting of spectral lines in an electric field because of the pro-Nazi and antisemitic actions of the Nobel Prize laureate.

Crease also highlights the involvement of Max Planck, Peter Debye, and Werner Heisenberg in Nazi Germany, suggesting that "textbooks would have to be rewritten, exams changed, and papers updated to avoid confusion" (p. 17). However, he acknowledges that renaming practices are typically only undertaken when they pose minimal inconvenience.

This sentiment is echoed by many scholars. In his examination of medical education, Cogan (1978) acknowledges that eponyms "may memorialize the wrong person" but "charisma also plays a role" (p. 2202). Similarly, Guedes et al. advocate for the removal of eponyms linked to individuals associated with imperialism, racism, and slavery in biological nomenclature. However, they reasonably anticipate that "such a proposal is unlikely to be implemented"

because of “very strong resistance among the taxonomic community to alterations of the codes” (Guedes et al., 2023, as cited in Slabin, 2023d, p. 188).

This aspect is delicately broached as a plausible but speculative factor. Delving into data regarding Mendeleev's political and ethical stances, alongside his personal attributes, psychological traits, and character, is avoided. However, it's worth noting that these aspects may hold significance for certain segments of the scientific community. Hence, acknowledgment of this factor as a potential contributor to the waning popularity of Mendeleevian eponyms is compelled.

Implications of Vanishment of Mendeleevian Eponyms from Chemical Education

Recognizing the valuable pedagogical potential of eponyms, they are advocated for preservation in education (Slabin, 2023b, 2023d). However, as eponyms, including Mendeleevian, experience rise, bloom, and fall, it becomes essential to address the negative consequences associated with their disappearance.

Loss of Historical Context

Like all eponyms, Mendeleevian eponyms bear the name of a significant figure in scientific history, and their removal can result in a loss of historical context. Students may miss out on learning about the contributions of this pioneering scientist and the historical development of the periodic law, system, and table.

Many researchers express concerns about the loss of historical context due to the vanishment of eponyms in science and education. Felts (1999) laments that “fifty years ago medical literature was more densely populated with eponyms: ghosts of 19th-century physicians” and acknowledges that “medical eponyms commemorate reporters of new findings” (p. 47). Similarly, Govindarajan et al. (1993) assert that “the historical merits of studying an eponym lie in the expressive power of appreciating and understanding its rich scientific history.” The commemorative function of eponyms is evident in their ability to “add interest to otherwise mundane or wordy labels, help preserve the history of medicine, and serve as a form of tribute to influential scientists and clinicians of the past” (Gall, 1960; Woywodt et al., 2007, as cited in Becker et al., 2021).

However, the content of education adheres to the principles of pedagogy in general and didactics in particular. Both the principles and the content are chiefly defined by educational policy in a given country, and the circumstances may necessitate their reassessment. Velychko (2023) contends:

The principle of historicism in the contemporary context is undergoing modification. In traditional teaching, historicism entailed emphasizing historical facts related to scientific discoveries, fostering motivation, and cultivating cognitive interest in teaching the subject. However, during the ongoing liberation war, the knowledge component expands to encompass the history of domestic science and production, acquainting students with the accomplishments of notable Ukrainian scientists, and illustrating practical implementations of scientific ideas. Amidst the liberation war waged by the Ukrainian people, historical information is perceived in a new light, and a deeper connection between learning and contemporary life is realized (p. 74).

In other words, priority is given to domestic scientists for education in Ukrainian schools, a decision that is understandable given the current conflict between the two countries. Therefore, in these circumstances, special attention should not be directed towards Mendeleev's personality and his eponyms.

Reduced Memorization Aids

Science education remains a problematic area of education (Slabin, 2007) and, therefore, requires effective memorization aids. Primary Mendeleevian eponyms serve as mnemonic devices, aiding students in remembering key concepts and discoveries by associating them with a specific name—Mendeleev. Without eponyms, students may find it more challenging to memorize and recall these concepts. “Mendeleev table” and “Mendeleev system” sound shorter and easier to remember than the “periodic system of the chemical elements”.

This perspective is supported by many researchers. “Medical eponyms (...) serve a mnemonic function because proper nouns can stand for involved processes or identify isolated observations” (Felts, 1999, p. 47). Snieckus (2010, as cited in Slabin, 2019b, p. 118) believes that for organic chemists there is “a direct cerebral cascade among name reaction–chemical structure–mechanisms that, for many of us, continues to succeed in information retrieval without Googling.” In medical education, Trüeb (2018) suggests that “the name may be shorter and more memorable than the

medical one (the latter requiring abbreviation to its acronym for mnemonic purpose or to circumvent problems with orthography in cultures not familiar with Latin)" (p. 76).

Ma & Chung (2012) describe eponyms as useful abbreviations and present Apert syndrome as an example:

Similar to how eponyms save us in times when we lack understanding, they also save time as an excellent shorthand reference for complex medical conditions and syndromes. The eponym "Apert syndrome" is much more practical than "acrocephalosyndactyly type 3," especially when one must also be careful to distinguish it from the related but different condition acrocephalopolysyndactyly." (p. 896e).

Impact on Critical Thinking:

Because primary Mendeleevian eponyms are linked to the central chemical theory, their removal can limit opportunities for critical thinking and analysis in chemical education. Without these eponyms, students may not be prompted to consider the origins or implications of the periodic law and system, express their opinions, question chemical concepts.

This implication is eloquently unpacked in "Science for All Americans: Project 2061" (1989), which states that students can only develop "a sense of how science really happens by learning something of the growth of scientific ideas, of the twists and turns on the way to our current understanding of such ideas, of the roles played by different investigators and commentators, and of the interplay between evidence and theory over time." (AAAS, 1989, p.148, as cited in Govindarajan et al., 1993).

Disruption of Continuity

Mendeleevian eponyms provide continuity in scientific terminology across different generations of chemists, teachers, and students, who readily recognize the Mendeleev system and Mendeleev table. Disappearance of eponyms can disrupt this continuity, that extends into other fields of science education. It will lead to confusion, inconsistency, and misunderstanding in scientific communication (Slabin, 2019c).

Reduced Cultural and Scientific Literacy

Primary Mendeleevian eponyms are part of Russian, Soviet, and international cultural and scientific legacy. Their removal can contribute to gaps in students' understanding of scientific culture and terminology of chemistry (Slabin, 2023a) and physics (Gabovich & Kuznetsov, 2024). It may also hinder students' ability to effectively engage with scientific literature and discussions, where the Mendeleev system and Mendeleev table are employed.

In alignment with similar concern for medical education, Ma & Chung (2012) stress that "eponyms lend a rare glimpse of a more philosophical and intangible aspect of medicine where they serve as a unique source of vitality and personality" (p. 897e). Trüeb (2018) further emphasizes that "the conscious and conscientious use of eponyms ultimately confers historical, literary, and cultural information that conveys the dignity of a broader educational background and understanding" (p. 77).

Reduced Humanism in Education

Like other eponyms, Mendeleevian are valuable for science education in terms of humanization (Slabin & Krasitski, 2017). Unveiling the history of Mendeleev table figuratively invites a company of purposeful, intelligent, and inquisitive people to the classroom: Meyer, Döbereiner, Newlands, Moseley, Rutherford, etc. Eponyms breathe new life into science, portraying it as an integral part of human endeavor. Consequently, the elimination of Mendeleevian eponyms would strip chemistry of its human touch.

In medical education, scientists recognize this value of eponyms, "ghosts of 19th-century physicians" (Felts, 1999). It is concluded that

Eponyms prompt us to remember the humanism of medicine. They may exemplify the life's work of a physician whose dedication laid the groundwork to treat patients even long after his or her time. Similar to how we are taught to see our patients as whole human beings rather than just diagnoses, we owe our own professional counterparts the same respect. Eponyms are often exalted as the highest honor one can ask for, and receive, in the medical field. (Rashid & Rashid (2007, as cited in Ma & Chung, 2012)

Ma and Chung (2012) point out that the value of eponyms diminishes when we overlook the individuals, events, and narratives they represent. As we progress into the era of evidence-based medicine, eponyms serve as a reminder that the field's advancement is not solely driven by machines and statistics but rather by the passion and dedication of human beings.

Perhaps, the most poignant and thought-provoking observation in this regard comes from Merton (1973):

Eponymy is the highest standard of acknowledgement in science, the hardest to achieve and maybe the most noted type of institutional recognition. It would be *one of the last traces of humanism* [emphasis added] that are still maintained in an impersonalized society more and more dominated by figures. (as cited in Slabin, 2019c)

How Significant Will be the Loss

On the other hand, one should rethink the excessive presence of Mendeleevian eponyms and his biography in Russian textbooks and courses. Is it possible to convey the essence of the periodic law without delving into the history of Mendeleev's thoughts and disposition? This is done, e.g., in most U.S. textbooks, and chemistry teachers do not see it a problem.

In chemistry, even without Mendeleev, there are enough eponyms associated with worthy individuals that can instill historicism and humanism, serve as memorization aids, develop critical thinking, or mention exemplars for educative teaching. Therefore, the disappearance of Mendeleevian eponyms will not affect U.S. and global chemical education because they were not prominent there in the first place.

No irreparable damage is also expected for Russian chemical education, although the density of the primary Mendeleevian eponyms and portraits per printed sheet in educational chemical literature is falling. Mendeleev as a cult figure and his eponyms will remain in Russian science and schools. Thus, "Sic transit gloria mundi" in the title of this paper pertains to the decline of Mendeleevian eponyms in all countries except Russia.

Limitations

While the reliability of the results and the identified trend are qualitatively essential, it's important to acknowledge several limitations in the current study. Firstly, it relied on a simple, albeit advertised as advanced, Google search for evaluative purposes. Secondly, the study encompassed only seven languages for the Google search and analyzed content from only two languages for chemistry textbooks. Thirdly, the focus was narrowed to just 27 textbooks for grade 8. Additionally, it did not capture the everyday use of Mendeleevian eponyms in classrooms, conferences, and other verbal communications. Lastly, the study was not designed to measure trends in the absolute educational use of eponyms over time. To enhance the quantitative validity, future research could utilize a more sophisticated search engine and conduct a broader content analysis over an extended period.

Conclusions

This research examined the current status and trends of Mendeleevian eponyms in chemical education, focusing on their prevalence, decline, and implications. By analyzing the evolution of Mendeleevian eponyms across different educational contexts, the study aimed to uncover factors influencing their decreasing usage and shed light on the impact of changing scientific terminology on educational curricula. The findings indicated a noticeable decline in the prevalence of Mendeleevian eponyms in contemporary educational discourse, especially outside of Russia. While primary eponyms like "Mendeleev periodic system" and "Mendeleev periodic table" still maintain some presence, non-primary eponyms are experiencing a significant decrease in usage.

The initial surge of Mendeleev and his eponyms in textbooks can be attributed to various factors. During the mid-20th century, Soviet authorities sought to promote domestic scientific achievements, including Mendeleev's, as part of a nationalist agenda. This led to their inclusion in Soviet textbooks, elevating Mendeleev's status as a national hero and scientific pioneer. The subsequent decline of Mendeleev and his eponyms in textbooks can be explained by changes in educational policies, following the collapse of the Soviet Union, resulting in a shift away from glorifying domestic scientists. Advances in scientific research and pedagogy have also contributed to a greater focus on contemporary developments in chemistry, diminishing the role of historical figures like Mendeleev in educational curricula.

The decline in the prevalence of Mendeleev and his eponyms in textbooks has implications for science education. It reflects a broader shift towards a more inclusive and internationally-oriented curriculum, acknowledging contribu-

tions from diverse scientists worldwide. However, this shift also risks erasing important aspects of scientific history and cultural heritage, necessitating critical evaluation, and updating of educational materials to reflect contemporary developments in science and pedagogy. Overall, this decline exemplifies the complex interplay between socio-political dynamics, educational policies, and scientific discourse, with implications for science education and society.

This research has significant implications for international education, offering insights into global trends in science education. By examining factors driving the initial surge and subsequent decline of Mendeleev's presence in textbooks, the study provides valuable perspectives on the dynamics shaping science education worldwide. The findings underscore the importance of a balanced and inclusive approach to science education, recognizing contributions from scientists of diverse backgrounds and perspectives.

Furthermore, this research highlights the interconnected nature of science education and international relations. The inclusion or exclusion of specific scientists in textbooks can influence how scientific knowledge is perceived and transmitted across borders, emphasizing the role of education in shaping international cooperation and cultural exchange in science.

Building on the findings of this study, several avenues for future research emerge. Firstly, further investigation into the factors driving the decline of Mendeleev and his eponyms in textbooks could provide a more comprehensive understanding of the forces shaping science education in the post-Soviet era. This could involve qualitative research methods such as interviews and focus groups with educators, policymakers, and curriculum developers to explore their perspectives on the representation of scientific history in textbooks.

Secondly, comparative studies across different countries and educational systems would be valuable for identifying common trends and variations in the representation of Mendeleev and other historical figures in science education. By examining how different cultural, political, and socio-economic factors influence the portrayal of scientific history, researchers can gain insights into the complexities of international education and curriculum development.

Thirdly, longitudinal studies tracking changes in the representation of Mendeleev and his eponyms in textbooks over time could provide valuable data on the evolution of science education and curriculum reform efforts. By analyzing trends in textbook content and educational policy, researchers can assess the impact of various factors, such as globalization, technological advances, and shifts in educational philosophy, on the portrayal of scientific history in textbooks.

Overall, future research in this area has the potential to deepen our understanding of the intersection between science education, cultural identity, and international relations, with implications for curriculum development, educational policy, and global cooperation in science education.

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