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Content Analysis of The Chemistry Book for The Second Intermediate Grade in Iraq in Light of Scientific Developments

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ABSTRACT

Objective: *This study aims to analyze the content of the second-grade chemistry curriculum in Iraq in light of recent scientific developments.* ***Method:*** *The researcher employed a descriptive-analytical approach. The researcher prepared a list of scientific innovations to be used as a curriculum analysis tool, aiming to determine the extent to which the curriculum incorporates these innovations.* ***Results:*** *The statistical results supported the hypothesis, showing that the chapters of the second intermediate grade chemistry textbook differ in their treatment of scientific innovations. In some chapters of the book, the coverage of scientific innovations reaches up to approximately 30%, indicating a higher concentration of these innovations in specific chapters compared to others.* ***Novelty:*** *The study identifies the varying extent to which scientific innovations are incorporated across different chapters of the second-grade chemistry curriculum, highlighting a concentration of innovations in certain chapters up to approximately 30%.*

INTRODUCTION

Research problem

"Our current era is witnessing a major scientific and technological revolution in all areas of life. The pace of change is accelerating at an unprecedented rate, presenting contemporary humans with ongoing challenges that require adaptation to these changes. "Therefore, education plays a crucial role in cultivating brains adept at critical thinking and invention. Curricula are crucial components of the educational process, designed to cultivate the human capital essential for holistic development. It is important to revise the curriculum in alignment with scientific and technological advancements to guarantee that students have the requisite information to confront contemporary and future difficulties, especially in chemistry and related disciplines".

"Studies have highlighted shortcomings in chemistry education, as seen in Al-Otaibi study, which limited the content to rigid chemical equations, provided insufficient learning experiences to understand chemical processes, and failed to focus on scientific applications [1]. In light of global trends calling for the modernization of science curricula, particularly in the field of chemistry, there is a need to conduct a study focused on developing chemistry curricula for the second intermediate grade".

Define the research problem

Main question: How does the second-year middle school chemistry textbook in Iraq address scientific innovations?

This leads to the following question:

Are there differences between the chapters of the second-grade chemistry textbook in their coverage of scientific innovations, as they represent 30% of the total and are concentrated in some chapters more than others?

Are there statistically significant differences in the percentage of scientific innovations among the chapters of the second-grade chemistry textbook?

Study hypothesis

Primary hypothesis: The second-grade chemistry textbook in Iraq covers less than 50% of scientific innovations.

Sub-hypotheses branch out from this

- There are differences between the chapters of the second-grade chemistry textbook in their coverage of scientific innovations, reaching 30% and concentrated in some chapters more than others.
- There is no variation in the percentage of scientific innovations among the chapters of the second-grade chemistry textbook.

The importance of research

The importance of this research lies in enhancing and developing chemistry curricula for the second intermediate grade by integrating modern scientific innovations that keep pace with rapid developments in the field of science and technology. Incorporating scientific innovations, such as green chemistry, nanotechnology, and modern environmental technologies, into the curriculum helps develop students' scientific and intellectual skills, making them more capable of addressing contemporary environmental and social challenges. This importance reflects the need to update scientific content to keep pace with rapid global changes, contributing to the preparation of a generation of students capable of innovation and problem-solving using modern scientific knowledge.

Theoretical Significance:

This research holds theoretical value due to its contribution to the advancement of knowledge concerning the formulation of chemistry curriculum at the intermediate level. This research enriches the theoretical knowledge of the link between scientific and technological growth and the requirements of educational curricula by emphasising the incorporation of scientific breakthroughs into the curriculum. "The research supports the theoretical framework for curriculum development by highlighting the need to integrate topics such as green chemistry and nanotechnology applications to meet students' needs and improve their learning in line with contemporary scientific progress".

Scientific Significance:

In terms of scientific importance, this research makes a practical contribution to improving and developing chemistry curricula for the second intermediate grade by integrating scientific innovations. "This contribution ensures that students learn modern scientific applications, such as nanotechnology and environmental chemistry, which enhance their critical thinking and problem-solving skills"."It also enhances students' ability to keep pace with technological and scientific developments in the field of

chemistry, enabling them to meet the environmental and technological challenges facing the world today".

Research Limits

- Objective: Content analysis of the second-grade chemistry textbook in Iraq, and scientific developments in the field of chemistry.
- Temporal: 2023.
- Spatial: Republic of Iraq.

Definition of Terms

1. Scientific Developments

- Theoretically, they are defined as everything new and modern in the scientific, technological, and educational fields at the contemporary scientific level, including information, knowledge, skills, technology, and pedagogy related to science education and its various components [2].
- Procedurally, they are defined as recent developments and innovations in the fields of science and technology, such as green chemistry, nanotechnology, and renewable energy, which are integrated into educational curricula to enhance students' understanding of the latest concepts and technologies in science.

2. Scientific Developments:

- Theoretical definition: Everything new in the field of chemistry, and some of the issues and problems arising from scientific research in chemistry in various fields.
- Procedural definition: Modern topics in chemistry, including eight major emerging issues.

3. Chemistry Textbook Content

- Theoretical definition: The scientific content encompassing the basic concepts and theories in chemistry, such as chemical reactions, atomic structure, and organic and inorganic chemistry.
- Procedural definition: The scientific material included in the chemistry textbook for the second intermediate grade, excluding drawings, figures, footnotes, and assessment questions.

Theoretical Framework and Previous Studies

First: Theoretical Framework

First Section: Content Analysis of the Second-Year Intermediate Chemistry Book in Iraq

1. The Concept of Content Analysis

It is described as a systematic process aimed at analysing textual or material information to infer its concepts and interpretations, as well as to derive the educational and cognitive advantages it provides. Bennie "claims that content analysis is an important tool for figuring out how well instructional materials fit with learning goals" [3]. This examination evaluates the effectiveness of curricula and their ability to provide students with the current knowledge and information they need. One part of the exam is looking at how textbooks and other educational materials show modern concepts and scientific progress.

Taher also pointed out that textbook content is a fundamental component of the curriculum. In the educational context, content analysis is used to review textbooks at all educational levels to ensure accurate and contemporary scientific content in line with modern scientific and educational trends [4]. This analysis includes examining the topics and elements covered in the books and their compatibility with modern educational standards.

Hymes and King indicate that content analysis is the process by which educational materials are examined to understand the extent to which they represent specific cognitive and pedagogical concepts, with the aim of improving teaching strategies [5]. This includes examining how topics are presented and whether they are linked to scientific and practical developments in the contemporary world [5]. Parker describes content analysis as a method that tries to disclose how scientific concepts are organised and distributed in a textbook or instructional material in a way that matches with scientific discoveries and the cognitive demands of students [6]. Phillips characterises content analysis within an educational framework as a systematic approach to evaluating the content of textbooks and instructional resources to assess their alignment with contemporary scientific and technological advancements [7].

2. The importance of content analysis

Content analysis is vital for judging how well textbooks and courses teach students the current ideas they need to know. The educational system needs new curriculum that keep up with advances in science and technology. Parker said that content analysis is important in this way [6]:

- Content analysis helps figure out how much new scientific and technical ideas, such nanotechnology and green chemistry, are included in the curriculum. Making it easier for students to learn about new scientific discoveries.
- Analysis helps make sure that curricula accomplish educational goals by giving pupils the right information and abilities to deal with today's problems.
- When students learn about science in an interactive way, they may improve their critical and creative thinking abilities, which help them keep up with the fast-paced world of science.
- Content analysis is a way to make sure that the scientific information in curricula satisfies the requirements for educational quality that current educational systems need.

3. Content analysis objectives

Phillips; Hymes & King say that the goals of content analysis are to enhance and make the curriculum more efficient in a number of ways [5], [7].

- Evaluating the compatibility of the scientific material with modern trends: This ensures that the curricula include scientific innovations in fields such as nano chemistry and green chemistry, which are important fields in the contemporary world.

- Determining the comprehensiveness of the textbook: The primary goal is to determine whether the textbook covers all the necessary topics that contribute to enriching students' knowledge and enhancing their scientific skills.
- Determining future directions for education: Through analysis, it is determined whether the textbook aligns with students' future needs in applied sciences and technology.
- Integrating theory and practice: Analysis can help ensure that the curricula provide students with the theoretical knowledge and practical skills necessary to solve scientific and technological problems.

4. Characteristics of content analysis

Content analysis is characterised by a set of characteristics that contribute to achieving its educational objectives:

- Content analysis requires a clear and organised process that begins with defining objectives and criteria, then moves on to examining the components of the educational material, such as concepts, values, and methods used.
- The focus is on how modern scientific topics and concepts are represented and their relevance to scientific developments [8].
- Content analysis can be adapted to any educational material, whether textbooks, educational videos, or even digital educational resources.
- Every aspect of the instructional material, from fundamental ideas to real-world examples, must be carefully examined and detailed in content analysis [6].

5. Content analysis criteria

Content analysis requires a set of criteria through which the educational material can be comprehensively evaluated. The most prominent of these criteria are:

- According to Abu Hussein, the scientific material must be entirely correct and represent the most recent findings in a variety of disciplines, including environmental chemistry and nanotechnology [9].
- The material must strike a balance between theory and practice, including contemporary issues in industry, technology, and the environment.
- It is also important that the information is compatible with recent scientific achievements, even in the fields of nanotechnology and green chemistry [8].
- The fact that the content should be applicable to the real needs of the students and that it should foster their scientific and critical reasoning abilities is important.

Axis II: Contemporary Scientific Innovations: Definition, Characteristics, Standards, and Objectives

One of the areas that must be given special attention in the contemporary education curricula is scientific innovations, especially in the area of chemistry since it captures the pace of scientific and technological changes that have led to the betterment of human living and the solution of environmental and health problems. In that regard, the United States of America Science Curriculum Reform Project reported the paramount significance of including these innovations into the curriculum, as it would equip students with the knowledge and skills they need in order to stay up to date with the

current scientific changes the world has to offer [10]. With the help of this project, the value of science and technology in everyday life is also added as well as the necessity to work out the curricula of the educational courses according to the latest changes in the sphere of science.

Although the Chemistry in People lives Curriculum Project emphasizes the need to incorporate science innovations, since they help in connecting science and technology, and increasing the practical knowledge of chemistry in ordinary life, Zaytoun elaborated that, with the introduction of innovations in science, it will help move science to a platform of theoretical knowledge to the realm of practical knowledge where students are given a chance to learn the relationship between chemistry and technology in an active and realistic way [11]. Teaching these innovations also contributes to the development of advanced scientific concepts and keeps pace with modern technological innovations, such as the use of nanotechnology in the fields of medicine and the environment, in addition to many other applications that keep pace with the rapid scientific development in this field.

From an educational perspective, Khalili points out that teaching students scientific innovations does not only aim to provide them with scientific information and knowledge, but also extends to developing their critical and independent thinking skills, thus enhancing their ability to analyze, solve problems, and make scientific decisions based on objective foundations [8]. When students acquire proficiency in scientific techniques such as observation, prediction, and inference, they are not simply memorizing information; they are also developing scientific thinking skills and applying these tools to problem-solving. This form of teaching cultivates their inherent curiosity and encourages students to pursue solutions to current scientific challenges, therefore enhancing their innovative capabilities.

Moreover, the instruction of scientific breakthroughs must encompass sophisticated environmental ideas, like e-waste and green chemistry, mirroring the increasing focus of the worldwide scientific community on environmental preservation. E-waste is a substantial environmental danger; thus, educating students on its management and implementing recycling methods might enhance their environmental consciousness. Conversely, green chemistry provides methods to mitigate environmental damage and attain sustainable growth. For instance, pupils can acquire procedures for transforming raw wood into solid blocks utilised in building. "This invention lowers building expenses and safeguards the environment by employing natural resources" [11].

"Incorporating scientific discoveries into courses facilitates student inventiveness. Students who study contemporary plastics, groundbreaking antibiotics, and environmentally beneficial chemicals, such as biofuel derived from rice straw, gain insight into significant modern scientific trends that address numerous environmental and economic issues" [12].

"Contemporary chemical applications, such the treatment of textiles for fire resistance and the development of self-cleaning materials, provide students with

practical skills applicable in daily life. These applications illustrate the capacity of chemistry to enhance human life quality and offer answers to modern difficulties".

"Ultimately, "research conducted by Al-Khudari, Al-Jabr, and Al-Shuaili underscores the necessity of integrating these advances into educational curriculum, therefore affording students the opportunity to comprehend contemporary advancements in chemical sciences and their applications" [13], [14], [15]. "The "incorporation of environmental chemistry into school curricula is essential for improving students' environmental consciousness, especially given the increasing worldwide apprehension over climate change and global warming".

Therefore, "it can be asserted that the examination of scientific innovations and their incorporation into curricula transcends merely augmenting students' understanding of recent scientific advancements; it also encompasses equipping them to address contemporary issues pertaining to the environment, health, and technology, thereby enhancing their preparedness to confront future challenges".

1. "Scientific developments in the field of education"

"Scientific innovations constitute a prominent domain experiencing ongoing advancement in chemistry. These innovations encompass all recent developments within the discipline, including scientific discoveries and research disseminated both locally and globally, which profoundly influence the environment and society. According to Al-Mukhtar, scientific innovations epitomise significant progress in chemistry research, as their repercussions on humanity and the environment become evident, fostering accelerated scientific and economic growth across various sectors" [16]. Furthermore, these innovations pose a fundamental challenge for science education in general, and for chemistry students specifically, as they facilitate learners' adaptation to these changes and enable them to derive positive benefits.

Jadou Haq asserts that scientific advances allow scientific curriculum to remain contemporary by integrating updates that fulfil current scientific and safety standards [17]. Scientific advances depend on advancements in chemistry, which can yield both beneficial and detrimental effects on humanity, the environment, and society. As new discoveries arise, the necessity to integrate these innovations into curricula becomes evident, guaranteeing that students are equipped to adapt to the continual changes in the area.

Characteristics of scientific innovations

A salient feature of scientific breakthroughs is their capacity to observe novel scientific events in the realm of chemistry, demonstrating their direct influence on research and practical applications in daily life. Nawar asserts that scientific breakthroughs include discoveries or inventions in chemistry that directly impact both living and non-living entities, including chemicals utilised in industries and daily items [18]. Scientific discoveries and engagement with them present a challenge that requires the creation of educational curricula specifically designed for these developments.

How scientific innovations are used to shape the educational curriculum

The innovations of science play a pivotal role in the development of chemistry curriculum, through which current information is shared out to the students in line with the requirements of the fast-growing scientific revolution in the field. "These improvements are crucial for augmenting students' environmental consciousness and refining their intellectual and scientific skills by extending their comprehension of environmental issues and empowering them to pursue chemical remedies. By incorporating these advances into the curricula of schools, learners can be exposed to the fundamental nature of chemistry in addressing critical issues of the world, such as pollution, climate change and conservation of natural resources. In this connection, Al-Bayati accentuates the need to ensure that the school curriculum is consistent with the global scientific development in achieving certain educational and environmental goals [19].

Scientific developments are important.

The scientific inventions enhance the ability of teachers to keep up with the ever-changing developments in the scientific field, giving them the ability to offer up-to-date knowledge, which can help students adapt to the demands of the rapidly changing world.

According to Marai and Al-Hila and Al-Wakeel, integrations of these innovations in the chemistry classes plays a major role in fostering critical and creative thinking in the learners [20], [21]. It also enhances the ability by educators to address and explain scientific subjects in new ways. In addition, the scientific breakthroughs play a great role in developing the research skills of learners and motivating them towards sustaining the contact with scientific developments and therefore developing their positive relationship with the scientific and cognitive environment.

Concepts in regards to innovation in science.

Green chemistry is one of the dominant concepts associated with the modern scientific achievements. It has been of interest in recent years as a vital demand and necessity of environmental protection and the sustainability of resources. Green chemistry aims to use chemicals in ways, which reduce negative impacts on the environment and enhance economic performance of industries. It tries to reduce the use of the damaging materials and develop safe and environmentally friendly substitutes that can be used in various industrial applications. Al-Bayati affirmed that the trend towards green chemistry has led to the creation of new, pollutant-free substances, which supplements the environmental protection efforts, and follows the global traditions of sustainable development [19].

1. Green Chemistry

Green chemistry is a modern field of chemistry that deals with the development of new safe and environmentally friendly methods of improving chemical procedures and reducing negative effects of chemical substances on the environment. This involves the utilisation of renewable raw materials, manufacturing of recyclable products and reduction of hazardous or non-biodegradable waste. Green chemistry focuses on the

application of effective technologies in order to reduce the harmful emissions as well as enhance the effectiveness of chemical processes [2]. Green chemistry has been seen as one of the emerging fields that have been at the forefront to meet global interests in environmental protection and sustainable development. The basic concepts that are going to be taught in this field include waste minimisation, the actualisation of the atomic economy notion and use of renewable raw materials. The main goal of green chemistry is to reduce the production of hazardous waste during chemical reactions and converting traditional processes into a secure and environmentally friendly form. By including this topic in the curriculum, students would understand the importance of chemistry in environmental conservation, and reduction of chemical pollution problems. This creates a culture of development of their critical thinking skills and adoption of newer and more sustainable solutions [22].

2. Nanochemistry

Nanochemistry is a modern branch of scientific research, which involves the exploration and development of materials at the nanometre dimension (under 100 nanometres) and their application in advanced industrial and medical applications. Such an extraordinary potential is known to modify the physical and chemical properties of materials that raise tremendous possibilities in the area of innovation in many fields, including microelectronics, renewable energy sources, and medicinal applications [23].

3. Solid-State Batteries

One of the recent breakthroughs in the energy storage technology is solid-state batteries. They use solid substances as electrolytes instead of the liquids or gels that were used in conventional batteries. Unique feature of these batteries is the high energy storage capacity and reduced risk of fires or explosions relative to the traditional varieties. Because of these features, solid-state batteries are considered a promising technology, which represents the future of energy storage systems, particularly in portable electronics and electric vehicles [24].

4. Biocatalysis

Biocatalysis is a modern method, which uses living organisms or enzymes to streamline chemical reactions, which offers a sustainable and more efficient alternative to traditional technology which often requires the use of solvents that are dangerous. The technique has widely been used in numerous industries, such as the food industry, pharmaceutical manufacturing, and petrochemical industries with the intention of improving the efficiency of processes and reducing the environmental impact [25].

5. Chemistry of Smart Materials

Smart materials are highly developed in the materials science field marked by their ability to change their physical or chemical properties in response to some external stimulus, e.g. heat, light, or pressure. This material has provided vast opportunities in its usage in various industries such as robots, wearable devices and advanced medical technology. The concept of smart materials plays an essential role in the modern technological revolution that combines environmental science with artificial intelligence

that will enable the creation of innovative solutions that will be used in future demand [26].

6. Chemistry with computers

Computational chemistry is a modern science which employs mathematical models and computer programs to study chemical reactions and predict the behaviour of materials. Such an approach has great opportunities in hastening the drug development process, improving the efficiency of industrial processes, and understanding the physical and chemical properties of nanomaterials. The outstanding precision and time- and effort-saving capability of computational chemistry have become an essential and important tool in the development of various chemical industries [27].

The use of scientific discoveries in learning.

Integration of scientific findings into the teaching material is a crucial foundation towards improving the standards of the teaching of chemistry and a component of significant curriculum construct. By introducing the concepts of green chemistry in the learning process students will be able to acquire the skills of critical and scientific thinking and thus, identify practical ways to overcome the environmental problem, as well as achieve the goals of sustainable development. Such integration not only builds positive environmental behaviours among the learners, but also increases their skills in research and innovation [28]. It can, therefore, be stated that scientific discoveries are not just an addition to the learning content, but a necessity in the preparation of future generations to tackle the present environmental and scientific issues, both in the immediate and at the international level.

Second: Previous studies

The article by Al-Zoubi aimed to analyze the curriculum of chemistry textbooks that are used in Jordanian high schools with an accent on scientific developments including green chemistry, nanotechnology, and renewable energy [29]. The author used a descriptive-analytical research design that relied on a content analysis tool that has primary categories that are related to these developments. It involved the analysis of three textbooks at 10, 11, and 12 grades level. The results showed that the content of such publications clearly reflected a deficiency of modern scientific developments, as the focus was often limited to traditional ideas, and such topics as nanotechnology and renewable energy were often omitted. The study recommended that the curriculum and textbooks should be revised to follow the current scientific development, therefore, enhancing the level of knowledge and participation of students in contemporary scientific and environmental issues.

The study of Al-Otaibi aimed to determine the extent to which the developments in the nanotechnology field are represented in the Saudi high school science textbook compulsory books [1]. The methodology adopted by the researcher was analytical and applied a content analysis tool, which included analytical categories, which covered numerous topics, such as complex chemicals, intelligent materials, and modern enzymes of the industrial world. The test consisted of five texts at the level of secondary education. The findings of the study showed that these publications could not adequately meet the

modern technical developments particularly in nanotechnology. The results revealed that there were profound gaps in integrating scientific innovations in the explanation of certain sophisticated scientific concepts, and there was a need to reform the curriculum to reflect rapid scientific changes.

The study conducted by Barghouthi focused on the analysis of the contents of the chemistry textbooks used in Palestinian schools as a means of evaluating the content related to scientific developments related to green chemistry [30]. The researcher had used a descriptive-analytical methodology and has used a content analysis tool that has covered categories and indicators related to green chemistry concepts, such as chemical waste treatment technologies and sustainable energy. The books that were analyzed include the tenth and eleventh grade chemistry textbooks. The research results revealed a clear lack in the comprehensive integration of the principles of green chemistry within textbooks. It also revealed that some relevant modern topics have been overlooked, and it is important to review the curriculum to introduce these ideas in respect of the current scientific developments.

In a study conducted by Al-Hamdani, the researcher aimed to analyze science and chemistry textbooks in Jordanian schools in relation to the current level of environmental developments, such as renewable energy, environmental conservation and pollution issues [31]. The researcher has used descriptive-analytical research methodology which has involved a content analysis tool which has incorporated analytical themes which are relevant in generating emerging environmental issues such as renewable energy technology and sustainable environmental practices. The test involved five specified science and chemistry textbooks that were used in Jordanian elementary schools. The findings of the study showed that there was a major deficiency in reporting on the issues of contemporary environmental concerns in these books and therefore a need to create curricula that reflected the need to include these important themes in the curriculum therefore creating environmental awareness among students.

Third: Commentary on previous studies

Similar and different aspects of the current study and the previous studies.

1. The current study agrees with previous studies in several key aspects, most notably the shared goal of analysing the content of chemistry textbooks in light of scientific innovations, such as nanotechnology, renewable energy, and green chemistry. They also share the use of a descriptive-analytical approach, which enables a precise understanding of the level of inclusion of these innovations in curricula, as well as the application of similar content analysis tools based on clear categories and indicators. Furthermore, the studies agree on the type of target sample, as they all focused on analysing textbooks in both chemistry and science in general, which aligns with the nature of the current study, which examined the chemistry textbook for the second intermediate grade in Iraq.
2. The differences lie in the geographical context. Previous studies have been conducted in countries such as Jordan, Palestine, and Saudi Arabia, whereas the current study focuses on Iraq, providing it with distinct environmental and

educational characteristics. The scientific innovations addressed by the studies also differ; previous studies focused on specific innovations, while the current study is more comprehensive, encompassing diverse chemical innovations that are appropriate to the local context. Finally, the scope of the target book distinguishes the current study, as it was limited to analysing one specific book (Chemistry for the Second Intermediate Grade - 2023 Edition), while other studies addressed multiple books and academic levels, making the current study more focused and specialized.

RESEARCH METHOD

This study employed a descriptive-analytical approach because it aligns with the study's objectives, focusing on collecting and analysing information to conclude. The descriptive-analytical approach is used explicitly in content analysis to assess the extent to which curricula conform to the general and specific standards required of any curriculum, in addition to measuring the degree to which these standards are met in the school curriculum under study [32].

Study Population

The study population for this research consisted of the content of the chemistry textbook for the second intermediate grade in Iraq, as well as the practical lessons assigned to students at this level. The study sample was determined by analysing the chapters included in the chemistry textbook for the first semester of the second intermediate grade. The following units were selected:

The chemistry textbook addresses the topic of elements and compounds in Unit 1. Chapter 1 focuses on elements and chemical bonding, followed by Chapter 2, which presents chemical compounds. Unit 2 addresses chemical reactions and solutions. Chapter 3 addresses chemical reactions, while Chapter 4 addresses solutions. Unit 3 examines acids, bases, and salts, beginning with Chapter 5, which discusses acids and bases, followed by Chapter 6, which presents chemical indicators and salts.

Accordingly, the study was limited to analysing the content of these chapters, including examples and practical experiments related to the chapter topics specified for the 2023 academic year. The study sample was determined based on the topics listed in the tables, with the paragraph as the unit of content analysis—any small, meaningful unit [32].

All paragraphs in the second-grade middle school chemistry textbook for the first semester were analysed, including ideas, figures, images, tables, comments, examples, exercises, and activities, as well as the entire paragraphs in the content box and the main content of the student's book. Practical experiments in the student's book were also analysed, as were activities related to daily life and community needs in the book.

Table 1. Chemistry book for the second intermediate grade in Iraq.

Unit	Chapter Title	Number of Lessons
Unit 1: Elements and Compounds	Chapter 1: Elements and Chemical Bonding	2
	Chapter 2: Chemical Compounds	2
Unit 2: Chemical Reactions and Solutions	Chapter 3: Chemical Reactions	3
	Chapter 4: Solutions	2
Unit 3: Acids, Bases, and Salts	Chapter 5: Acids and Bases	2
	Chapter 6: Chemical Indications and Salts	2

Study tool

It is a content analysis tool used to analyse the chemistry book for the second intermediate grade, determining the extent to which scientific innovations are included in the book.

Validity and Reliability

1. Validity

Construct Validity: Construct validity was assessed by comparing the content of the analysed chemistry textbook with the latest research and scientific references in the field of chemistry. Chemistry experts reviewed the scientific advancements investigated to make sure they were in line with what is currently known about chemistry and what is happening in the field.

Face Validity: It was established that the book clearly shows new scientific ideas and is based on the most recent ideas in the field of chemistry. Content analysis showed that the chapters had current scientific information, such nanotechnology and advanced composite technologies. Thus, it was verified that the book embodies scientific principles aligned with contemporary developments in chemistry. **Internal Validity:** Each chapter addressing new discoveries was confirmed to have precise and dependable information on scientific ideas. The information aligned with contemporary scientific literature, demonstrating good internal validity.

2. "**Reliability**"

Al-Otaibi's research aimed to assess the extent to which advancements in nanotechnology are incorporated into the scientific textbooks used in Saudi educational institutions [1]. The researcher employed an analytical methodology, utilising a content analysis instrument that encompassed analytical categories addressing subjects such as sophisticated chemicals, intelligent materials, and contemporary industrial enzymes. Five secondary school science textbooks were examined. The study's findings indicated that scientific textbooks are inadequately aligned with contemporary technological advancements, particularly in the field of nanotechnology. Deficiencies were identified in the incorporation of innovations to elucidate advanced scientific topics.

Inter-rater reliability: The book was analysed by two independent analysts using the same tool and criteria. Cohen's coefficient between the analysts was calculated and found to be 0.85, indicating a high level of agreement between the analysts and thus demonstrating inter-rater reliability.

This study utilised calculations for validity and reliability.

Since the content in the book was verified to be in line with the most recent chemical research, construct validity was excellent. Because the data accurately represented current scientific trends, internal validity was also strong. A Pearson's correlation coefficient of 0.91 demonstrated cross-stage reliability, indicating that the findings remained stable and consistent when reanalysed.

The inter-analyst reliability was 0.85, signifying a substantial degree of concordance among the analysts. The analysis indicates that the book exhibits substantial validity and reliability, hence assuring the dependability of the conclusions in this study.

An examination of the second-grade chemistry textbook indicates a variety in the treatment of fundamental subjects and concepts throughout the different chapters. The book encompasses a collection of fundamental chemical ideas organized throughout the chapters. This distribution is evident in the quantity of examples and actual experiments, as well as the degree to which scientific advances and applications are discussed in each chapter. The chapters differ in the breadth of knowledge presented, influencing the degree to which educational objectives are met comprehensively and equitably.

Table 2. Content analysis of the chemistry book for the second intermediate grade.

Chapter Title	Basic Concepts	Number of examples	Number of practical	Address the scientific innovations	Scientific applications	Figures and illustrations	Tables	Supporting Explanation	Exercises and Activities
Chapter One: Elements and Chemical Bonding	States of matter (solid, liquid, gas)	3	2	Weak	Average	4	1	3	5
	Physical and chemical properties of matter	4	3	Weak	Average	3	1	2	4
	Physical and chemical changes	3	2	Average	Good	5	1	4	6
	Classifying matter into elements, compounds, and mixtures	4	2	Average	Good	3	1	2	4
Chapter Two: Chemical Compounds	The difference between homogeneous and heterogeneous mixtures	3	2	Weak	Good	2	1	3	5
	Methods for separating mixtures (decantation, filtration,	4	3	Weak	Good	4	1	2	5

	distillation, crystallisation)								
	The concept of chemical reactions	3	2	Weak	Weak	3	1	2	4
Chapter Three: Chemical Reactions	Types of chemical reactions	4	3	Average	Average	5	1	3	5
	Balancing chemical equations according to the law of conservation of mass	5	2	Weak	Weak	4	1	3	6
	The concept of a chemical bond	3	1	Weak	Weak	3	1	2	4
Chapter Four Solutions	Types of chemical bonds	4	2	Average	Average	5	1	3	6
	Valence electrons and their effect on chemical bonds	5	1	Weak	Weak	4	1	2	5
	Definition of acids and bases according to the Arrhenius,	4	2	Weak	Average	4	1	3	5
Chapter Five: Acids and Bases	Brønsted, and Lowry theories								
	Properties of acids and bases	5		Average	Average	3	1	2	4
	Ph and its effect on various substances		3	Average	Average	3	1	2	6
	The concept of solutes and its relationship to the solvent and solute	6	2	Weak	Average	4	1	2	4
Chapter Six: Chemical Evidence and Salts.	Factors affecting solubility	4	2	Average	Average	3	1	2	5
	Types of solutions	5	3	Average	Average	2	1	2	4

Table 2 analyses the second-year intermediate chemistry textbook in Iraq, revealing a marked disparity in the extent to which scientific innovations are covered across chapters. Chapter 1 focused on the basic concepts of states of matter, with weak coverage of scientific innovations and applications. Chapter 2 saw a relative improvement by presenting some modern applications of chemical compounds, while Chapter 3 featured a good coverage of scientific innovations and modern industrial applications of chemical reactions. Chapter 4, on the other hand, talked about the underlying ideas behind chemical bonding without going into new scientific discoveries. Chapter 5 on the other hand provided excellent information on acids and bases without leading to new research. Chapter 6 had been written in an ordinary manner and had not discussed any novel concepts or developments in the subject of solubility. The imbalance in the representation of scientific discoveries in textbooks shows a lack of content exhaustiveness and failure to keep pace with the current developments in chemistry thus compromising its effectiveness in promoting modern scientific understanding in students.

RESULTS AND DISCUSSION

Results

An Analysis of the Balanced Coverage of Scientific Innovations in the Second-Year Intermediate Chemistry Textbook

The examination of the balanced coverage of the scientific innovations in the second-grade chemistry textbook showed that there was a conspicuous discrepancy in the number of updates shared in the chapters. New chapters were added to some of them and they helped to add more content like chemical compounds, chemical reactions, chemical indicators, and salts. Other chapters like elements, chemical bonding, solutions and acids and bases, were left unaltered to a large extent. This contrast demonstrates that the book lacks balance as scientific progress prevails in certain areas of the book. This might make the scientific material less complete and less up-to-date with the latest discoveries in chemistry.

Table 3. The extent of the balance in the coverage of scientific innovations in the chemistry book for the second intermediate grade.

Chapter Title	Added Updates	Scientific Innovations
Chapter One: Elements and Chemical Bonding	0	0%
Chapter Two: Chemical Compounds	Modern methods have been added to the mixtures chapter, such as simple distillation.	20%
Chapter Three: Chemical Reactions	Some modern theories about chemical reactions and balancing chemical equations have been added.	25%
Chapter Four: Solutions	No clear chemical innovations have been added.	0%
Chapter Five: Acids and Bases	No innovations related to modern acids and bases have been added.	0%
Chapter Six: Chemical Indications and Salts	Modern examples have been added about factors affecting solubilities and their applications in scientific life.	15%

An examination of Table 3 indicates a distinct imbalance in the representation of scientific advances throughout the chapters of the chemistry textbook for the second intermediate grade. Updates were focused on particular chapters, notably chemical reactions, which had the highest update rate of 25%, incorporating contemporary ideas and information regarding equation balance. Chemical compounds, with a 20% update rate, encompassed contemporary separation techniques, including simple distillation. Chapter 6 recorded a 15% update rate, featuring recent cases of disintegration. Conversely, several chapters, including elements and chemical bonding, solutions, and acids and bases, have no new additions. This signifies a disparity in the allocation of

scientific advances within the book, constraining the thoroughness of the information and its capacity to remain current with recent advancements in chemistry.

Discussion

The main idea is that the second-year middle school chemistry book in Iraq doesn't cover more than 50% of new scientific ideas.

This hypothesis sought to quantify the degree to which scientific breakthroughs are addressed in the second-year intermediate chemistry textbook in Iraq, at a threshold of less than 50%. An analysis of the second-year intermediate chemistry textbook based on content showed that scientific developments were not equally and comprehensively integrated in all chapters. Some chapters markedly new topics, such as illustrations of new chemical compounds and nanotechnology, where other chapters covered such developments shallowly or not at all. The results showed that the occurrence of innovations on the book was not high in some of the chapters, with most of them failing to exceed 50.

Main hypothesis result:

The presented data and the results of the analysis prove the initial assumption. In Iraq, the textbook used in chemistry in the second grade covers less than half of the scientific developments. It means that they have not covered recent scientific developments in the curriculum comprehensively, depriving students of the opportunity to become familiar with important developments in chemistry and keep up with the latest scientific developments.

Discussion of the principal result:

The results show that there is a serious lack of updating the textbooks on chemistry used in Iraq in time to abreast with the modern scientific development. This finding is consistent with previous studies carried out by Al-Zoubi, Al-Otaibi, Al-Barghouthi, and Al-Hamdani, who found gaps in curriculum revision to align with the progress in most areas of science [1], [29], [30], [31]. The difference in response to new breakthroughs could be caused by various factors, including the difficulty in applying the newest scientific knowledge in the curriculum or the absence of necessary periodic assessments to maintain the correspondence between curricula and new scientific developments. The limited references to current developments in the book do not facilitate the ability of the students to connect with the new scientific developments. Consequently, there is a pressing need to reform curriculum in order to accommodate modern scientific courses that are in tandem with modern developments in the chemistry field.

The initial hypothesis is that the chapters in the second-year middle school chemistry textbook vary in their coverage of scientific innovations with the proportion of their coverage not surpassing 30 per cent and that the proportion of this coverage in some chapters is higher than in others.

Result of the first hypothesis:

Hypothesis testing results indicate clear differences in the coverage of scientific innovations across the second-grade chemistry textbook chapters, with some chapters

covering nearly 30% of these innovations. Scientific innovations were more focused in certain chapters and the others were conspicuously deficient in this regard. This observation is especially in accordance with the results of the study by Al-Zoubi, who also revealed a difference in the inclusion of scientific innovations in the textbook content on chemistry [29]. The chapters on contemporary issues like green chemistry and nanotechnology had more coverage than those who did not receive such coverage. The difference can be explained by the fact that some chapters discussed innovations using applied examples, scientific experiments, and contemporary ideas, whereas other chapters did not. This is an indication of the desire to have a higher balance in incorporation of scientific innovations in textbook material.

Discussion of the first hypothesis result:

The findings reveal that the chapters of the book tended to emphasize on scientific developments greatly by providing applied examples, scientific experiments, and modern images and figures whereas other chapters were not largely inclined towards these features. This indicates the loose establishment between the academic content of the book and the scientific developments in certain areas. Hence, some of the chapters should be updated further to meet the recent trends on the science of chemistry. This may be done through incorporation of varied scientific applications, application of the outputs of current research and through explanatory support that puts students in touch with modern day knowledge.

The greater emphasis on innovations in specific chapters may reflect an attempt to motivate students to stay current with recent developments in science. However, the disparity in coverage of innovations between chapters may leave knowledge gaps among students who may not be exposed to some of the recent topics in other parts of the book. Therefore, it is recommended that innovations be distributed evenly across all chapters to provide a comprehensive education that reflects the latest developments in chemistry.

The second hypothesis states that there is no variation in the percentage of scientific innovations between the chapters of the chemistry book for the second intermediate grade.

Discussion of the result of the second hypothesis

From the table, we find an apparent disparity in the percentages of scientific innovations between chapters. For example, in Chapters One, Four, and Five, no new chemical innovations were added (0%). In contrast, 20% were added in Chapter Two, 25% in Chapter Three, and 15% in Chapter Six. If the null hypothesis were true, this disparity in the percentages between chapters would not be statistically significant. Thus, scientific innovations would be evenly distributed across all chapters of the book. However, given the significant disparity in percentages between chapters, the information does not necessarily agree with the null hypothesis and the fact that there is most likely to be a statistically significant difference between the chapters.

Alternative hypothesis: There is a statistically significant difference in the percentage of scientific innovations between the chapters of the chemistry book for the second intermediate grade.

Discussion of the alternative hypothesis

Upon rejection of the null hypothesis, we proceed to the alternative hypothesis. This indicates variability in the presentation of scientific developments throughout the chapters of chemistry textbooks. The data in the table indicates that certain chapters, including Chapter 1, Chapter 4, and Chapter 5, lack any chemical inventions (0%), whilst other chapters, such as Chapter 2 and Chapter 3, exhibit scientific breakthroughs at rates reaching 25% in certain instances. This shows that the book gives precedence to updates in some of the themes as compared to others, which may be reflective of the variances in the quality of revised information across the chapters.

The outcome indicates there is an imbalance in the chemistry textbook regarding the updating of information and scientific progress which suggests the need to revise the curriculum and make these developments a more balanced thread throughout the text. The given finding is in line with the results of the study of Al-Otaibi, who examined the content of science textbooks at Saudi schools. This work has found that there are imbalances in the coverage of nanotechnology developments in the textbooks though some chapters have been covered than others [1]. This difference in chapters corresponds to the poor completeness of the curricula and unevenness in scientific development coverage, which is in line with the finding in the second hypothesis. As an illustration, Chapter 1 (Elements and Chemical Bonding) and Chapter 4 (Solutions) should have further revisions that will incorporate new scientific discoveries in such disciplines to further make the material more effective.

As a result of the analysis, the difference in the coverage of the scientific innovations in the different chapters of the chemistry textbook was determined to be clearly present in its nature. This finding indicates that the alternative hypothesis is more realistic because the chapters are not written in the same line of the incorporation of scientific innovations. This inequality is an indication of the necessity to facilitate a balanced delivery of contemporary scientific content in all chapters so that students have equal chance to learn modern and comprehensive information on a wide range of chemistry subjects.

CONCLUSION

Fundamental Finding : The analysis indicates that the second intermediate grade chemistry textbook does not fully reflect recent scientific developments in all chapters. Some chapters lack modern scientific experiments and practical examples, which could otherwise increase students' interest in contemporary scientific ideas. Additionally, the textbook does not consistently connect academic material with scientific advances, limiting the development of learners' scientific knowledge and the application of theoretical concepts in practical contexts. **Implication :** To enhance student engagement and learning outcomes, the content of the chemistry textbook should be modified to incorporate scientific developments in a balanced and thorough inclusive way across all chapters. Adding modern experiments, practical examples, and interactive exercises will help students follow scientific progress and link it to chemistry lessons. Updating

illustrations and examples to reflect contemporary scientific applications can clarify modern concepts and foster the integration of theoretical knowledge with real-world applications. **Limitation:** Currently, the textbook provides limited exposure to advanced scientific topics, which restricts students' understanding of emerging fields such as nanotechnology and artificial intelligence. The absence of dedicated units or appendices on scientific developments at the end of each chapter narrows students' horizons and reduces opportunities for learners to independently explore contemporary science. **Future Research :** Further studies could focus on designing and evaluating additional units or appendices that cover modern scientific developments, as well as creating interactive exercises that connect these advancements to the chemistry curriculum. Expanding the scope of new topics to include advanced technologies and assessing their impact on students' understanding and interest in science can provide insights for continuous improvement of educational materials.

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