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Content Analysis of the Physics Section of the Sixth Grade Elementary Science Textbook (2024 Edition)

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ABSTRACT

The aim of this study is to analyze the content of the physics section of the sixth-grade elementary science textbook (2024 edition) to evaluate the level of student engagement based on William Rumi's method. Data were collected from the text, questions, and exercises of lessons 6, 7, 8, 9, and 14 and analyzed from both active and passive perspectives. The findings indicate an overall engagement coefficient of 0.62, suggesting a moderate level of active learning promoted by this section of the textbook. A more detailed analysis reveals that the text has a high engagement coefficient of 1.2, and the questions, with a coefficient of 0.42, also play an active role in encouraging student participation. However, the images section shows a low engagement coefficient of 0.25, indicating a weaker contribution to active engagement. The results underscore the importance of revisiting textbook content design to enhance educational quality and promote active student involvement.

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INTRODUCTION

Textbooks are essential tools designed to achieve educational goals. They include various components such as textual content, images, and questions [1]. To enhance educational quality, many countries continuously conduct research focused on improving their textbooks to meet higher teaching and learning standards. This is based on the understanding that improving textbook quality significantly optimizes the teaching–learning process and facilitates deeper, more effective student learning. Consequently, ongoing review and revision of instructional content have become key strategies in advanced education systems.

The importance of textbooks is highlighted by studies showing that approximately 50% of science teachers worldwide heavily rely on textbooks during instruction [1]. Therefore, developing effective textbooks capable of fostering positive behavioral and attitudinal changes in students requires comprehensive research to ensure the learning process is implemented efficiently [2] Furthermore, textbooks are considered one of the primary sources of student motivation, which plays a critical role in learning, especially in centralized educational systems where it demands special attention [3-4].

Textbooks also act as the primary link between educational systems and learners. Their content profoundly influences students' personality development, shaping their identities and future roles [5]. based on scientific principles, and responsive to current societal needs. This is particularly true in centralized systems such as Iran's, where most teaching components are designed around textbooks, underscoring the need for comprehensive, accurate, and pedagogically sound content [6]. Such resources should aim to nurture innovative, committed, and creative individuals capable of adapting effectively to societal changes [7].

Content analysis of textbooks is a powerful tool for identifying strengths and weaknesses in educational materials. It provides a clear picture of the current status of textbook content and aids in the continuous improvement and refinement of these resources, ultimately supporting educational objectives [8].

To better understand the impact of active curricula on education, one can refer to Comparative studies, such as those analyzing chemistry curricula in Japan and Iran, show that Japan's education system emphasizes student engagement and activity-based learning, leading to deeper and more practical learning experiences. Conversely, the Iranian curriculum's lack of such approaches is cited as a major factor in lower academic performance and student engagement [9]. This highlights the necessity for textbooks to be designed based on participatory and activity-oriented frameworks to actively involve students in the learning process [10].

Primary education lays the foundation for lifelong learning and profoundly influences adulthood. Therefore, fostering the right kind of thinking during this stage is crucial. Access to dynamic, effective, and engaging textbooks that satisfy students' curiosity is essential for sound decision-making in later life and academic success in higher education [4]. Accordingly, curriculum developers must ensure that textbooks—particularly those directly related to real-life contexts, such as science—are structured to maximize student engagement.

The present study aims to evaluate the physics section of the sixth-grade elementary science textbook in Iran, specifically the 2024 edition, to determine the extent to which it supports active versus passive learning based on William Romy's content analysis model.

Literature Review

Any academic research must be grounded in a thorough review of prior studies related to the subject. In this section, several relevant studies are presented, focusing on both the physical structure of textbooks and the degree of active versus passive learning content based on William Romy's methodology:

Nourian (2008) emphasized that textbooks at lower educational levels should include more visual content and less written text. This structure better supports young learners in understanding concepts. As students' progress to higher levels, the inclusion of more complex written content becomes more appropriate [11].

In a comparative study by Sharafi et al. (2019) titled "A Comparative Study of Chemistry Curricula in Iran and Japan at the Upper Secondary Level", the authors argue that hands-on activities should be a fundamental component of science education. They highlight Japan's educational advancement as largely due to students' strong engagement in active learning processes [9].

In a content analysis study by Khadami and Ghoreishi-Nasab (2016) titled "Analysis of the Sixth Grade Science Textbook from the Perspective of Active and Passive Learning Based on William Romy's Method", the interaction coefficient of the textbook text was calculated as 1.49, indicating an active text. The images in the textbook were also found to be active with an engagement coefficient of 1, while the questions showed an even higher coefficient of 3.5, suggesting that students are encouraged to engage in activities even in the absence of detailed textual explanations [2].

Ramazani and Dashti (2021), in their study "Content Analysis of the Sixth Grade Elementary Science Textbook Using William Romy's Technique", found the text engagement coefficient to be 0.34, which is below the desirable threshold and indicates that the textual content is relatively passive. However, the coefficients for questions (1.7) and images (0.8) demonstrated a more active role in stimulating student curiosity and critical thinking. These results highlight the need for textual revisions and the use of active teaching strategies to improve learning outcomes [12].

In a more recent study, Chandool (2023) analyzed the fourth-grade science textbook using Romy's method and found that, while the textual content met engagement standards, images and activities needed improvement to enhance student participation in the learning process [13].

Similarly, Ahmadi et al. (2021) conducted a study titled "Content Analysis of Biological Topics in Fifth and Sixth Grade Elementary Science Textbooks Using William Romy's Technique". Their findings indicated that the biological content and related visuals were moderately active, though still below optimal levels [14].

In another study by Goudarzi (2016) analyzing the sixth-grade science textbook, the text engagement coefficient was reported as 0.67, indicating a moderately active text. The question coefficient was 1.27, showing good levels of student engagement, whereas the coefficient for images and tables was only 0.38, highlighting their passive nature and limited role in promoting interaction [15].

METHODOLOGY

This study employs a quantitative descriptive content analysis methodology, focusing on the science textbook for sixth-grade elementary students published in the 2024–2025 academic year (1403 in the Iranian calendar). To allow for a more targeted analysis, only the physics section of the textbook was selected for examination.

The analysis is grounded in William Romey's content analysis model, which classifies textbook content into three categories based on their potential to engage students: active, passive, and neutral elements.

- **Active elements** include sentences, questions, or illustrations that prompt students to engage in investigative, experimental, inquiry-based, or discussion-oriented activities. These are designed to foster cognitive involvement and hands-on learning.
- **Passive elements** present information without requiring any student interaction or response, thereby limiting engagement.
- **Neutral elements** neither contribute to the instructional content nor stimulate cognitive or practical involvement—for example, decorative images or non-instructional statements.

To assess the level of learner engagement, a Content Engagement Index was calculated for each element type (text, questions, and images) using the formula proposed by Romey:

$$\text{Engagement Index} = \frac{\text{Number of Active Elements}}{\text{Number of Passive Elements}}$$

engaging (i.e., active) content level. Values below 0.4 or above 1.5 suggest that the content may be insufficiently or excessively stimulating, potentially undermining effective learner engagement.

All sentences, questions, and illustrations within the selected content were independently coded by two trained raters. Inter-rater reliability was assessed using Cohen's kappa coefficient to ensure consistency in coding. Finally, the categorized data were analyzed using descriptive statistics, to determine the degree of engagement across each category.

Sampling Procedure

To conduct the content analysis, the entire physics section of the sixth-grade elementary science textbook—including lesson texts, illustrations, and questions—was initially reviewed. To ensure analytical clarity and manageability, a subset of content was selected through random sampling.

Specifically, 10 pages were randomly chosen from the physics section using a random number table. This method was designed to achieve a representative distribution of content across the entire section. The selected pages spanned the full range of the physics material—from the beginning to the end of the section—with at least one or two pages included from each chapter.

From these same 10 randomly selected pages, 10 questions (from both in-text and end-of-lesson exercises) and 10 instructional images were extracted. This ensured that all samples—texts, questions, and images—originated from a consistent and representative subset of the physics content.

These selected elements served as the units of analysis for subsequent coding and evaluation.

Research Objectives

The primary objective of this study is to evaluate the level of student engagement within the physics section of the sixth-grade elementary science textbook for the 2024–2025 academic year. Specifically, the research investigates the extent to which the textbook content promotes active student participation across three modalities: text, images, and questions. The study aims to determine how effectively the textbook supports an interactive and learner-centered environment by encouraging cognitive and practical engagement. Ultimately, it seeks to assess whether the textbook offers a pedagogical framework that aligns with active teaching and learning principles.

Research Questions

1. To what extent is the textual content of the sixth-grade science textbook (in the physics section) active and capable of engaging students in the learning process?
2. To what extent are the questions included in the physics section of the textbook active and effective in promoting student engagement?
3. To what extent are the images and illustrations in the physics section of the textbook active and capable of stimulating student involvement in the learning process?

Population and Sample

The target population of this study is the sixth-grade elementary science textbook used in the 2024–2025 academic year, which comprises four main content areas: chemistry, physics, biology, and earth sciences. Given the breadth and diversity of these disciplines, analyzing all sections within a single study would compromise the depth and focus of the analysis. Therefore, to ensure analytical clarity and manageability, the study focuses exclusively on the physics section of the textbook.

The physics content is presented across five lessons, as follows:

- Lesson 6: Motion and Force I
- Lesson 7: Motion and Force II
- Lesson 8: Let's Design and Build
- Lesson 9: The Journey of Energy
- Lesson 14: From Past to Future

According to a preliminary content audit (see Table 1), the physics section spans 37 pages, making it the most extensive section in terms of page count. This indicates its substantial weight in the overall science curriculum.

Sampling was conducted using a random selection method to ensure a representative subset of the physics content. Selected samples included lesson texts, instructional images, and exercises, distributed across the entire section to capture a wide range of topics and presentation styles. This approach strengthens the generalizability and reliability of the findings by reflecting the diversity of the section as a whole.

Table 1. Statistical Overview of the Physics Section by Lesson Components

lessons / Sections	Lesson 6 **Sports and Force (1)**		Lesson 7 **Sports and Force (2)**		Lesson 8 **Let's Design and Build**		Lesson 9 **Energy Journey**		Lesson 14 **From the Past to the Future**		**Total**	
	Pages	**Images**	**Pages**	**Images**	**Pages**	**Images**	**Pages**	**Images**	**Pages**	**Images**	**Pages**	**Images**
Lesson Text	8	12	12	9	6	7	8	13	3	10	**37**	**51**
Experiment	1	3	5	11	0	0	2	2	0	0	**8**	**16**
Inquiry	1	1	1	6	2	17	0	6	0	3	**4**	**33**
Think About It	2	5	6	5	0	0	4	2	0	0	**12**	**12**
Information gathering	0	0	1	0	0	0	0	0	0	2	**1**	**2**
Discussion	1	0	2	2	1	0	2	1	1	0	**7**	**3**

Science and Life	2	2	1	4	0	0	1	0	1	0	**5**	**6**
Activity	2	0	2	0	1	0	0	0	0	0	**5**	**0**
Wonders of creation	1	0	2	1	0	0	1	1	0	0	**4**	**2**
Warnings	0	0	0	0	0	0	1	0		0	**1**	**0**
total		23		38		24		25		15		**125**

FINDINGS

Text Content Analysis

To examine the level of engagement in the textual content of the sixth-grade science textbook, ten pages from the physics section were randomly selected and analyzed. In accordance with William Romy's framework, as described in the methodology section, a total of 87 sentences were identified and categorized into three groups: active, passive, and neutral. The **passive** categories included:

- *Category a*: statements presenting established scientific facts
- *Category b*: statements linking two propositions
- *Category c*: definitional statements
- *Category d*: immediate answers to questions

The **active** categories consisted of:

- *Category e*: analytical interpretations of data
- *Category f*: prompts encouraging students to draw conclusions
- *Category g*: invitations to perform specific activities
- *Category h*: open-ended questions raised in the text without being directly answered

The **neutral** category was represented by *Category I*, encompassing sentences that were neither clearly active nor passive in their engagement with the learner.

A total of 89 sentences were identified across the selected pages. Among them, 37 sentences were classified as active, 30 as passive, and 22 as neutral. According to William Romy's formula for calculating the engagement index:

$$\text{Engagement Index} = \frac{37}{30} \approx 1.2$$

The resulting index of 1.2 indicates a relatively high level of student engagement in the textual content of this section. This suggests that the text effectively encourages students to think critically, ask questions, and participate in active learning processes.

However, the presence of 22 neutral sentences (approximately 25% of the total) is noteworthy. These may represent areas of the content that are less pedagogically effective or that warrant revision to enhance their educational value. Detailed results are presented in Table 2.

Table 2. Content Analysis of the Sixth Grade Science Textbook (Physics Section) Based on the Text Engagement Index

Categories	Passive				active				Neutral
pages	a	b	c	d	e	f	g	h	I
40	2	1	1	---	1	---	---	---	1
45	---	---	---	---	4	1	---	1	5
48	3	4	1	---	2	---	---	---	---

52	1	1	---	---	3	---	4	2	4
58	2	1	1	---	---	1	1	---	---
60	---	---	---	1	---	1	1	---	5
63	---	---	---	---	---	1	1	---	3
67	3	2	---	3	3	1	---	1	---
71	3	---	---	---	2	1	1	1	4
103	---	---	---	---	2	---	---	1	1
	14	9	3	4	17	6	8	6	22
Total Passive Categories					Total Active Categories				Total Neutral Categories
30					37				22
1.2					Engagement Index				

Analysis of Question Content

To examine the level of engagement elicited by the questions in the physics section of the sixth-grade science textbook—specifically those framed as activities, experiments, information gathering, and discussions—10 questions were randomly selected from the previously identified 10 pages of this section and analyzed.

Based on William Romy's framework, each question was categorized as either passive or active:

- Passive questions were labeled as:
  - (a) Questions requiring minimal effort to answer
  - (b) Questions related to definitions
- Active questions were labeled as:
  - (c) Questions related to lesson comprehension
  - (d) Questions that lead to problem-solving

The analysis results, presented in Table 3, showed that out of the 10 questions analyzed (3 active and 7 passive), the engagement index was calculated as 0.42. This value indicates that the questions in this section demonstrate a moderate level of engagement, meaning they only partially involve students actively in the learning process.

The engagement index was calculated using the following formula:

$$\text{Engagement Index} = \frac{3}{7} \approx 0.42$$

Table 3. Content Analysis of the Questions in the Sixth Grade Science Textbook (Physics Section) Based on the Question Engagement Index

Categories / pages	Passive		active	
	a	b	c	d
40	*	---	---	---
45	*	---	---	---
48	---	*	---	---
52	*	---	---	---
58	---	*	---	---
60	*	---	---	---

63	---	---	---	*
67	---	*	---	---
71	---	---	---	*
103	---	---	*	--
	4	3	1	2
Total Passive Categories			Total Active Categories	
7			3	
0.42			Engagement Index	

Analysis of Visual Content

To evaluate the level of student engagement through visual elements in the physics section of the sixth-grade science textbook, 10 images were randomly selected from a total of 125 and analyzed according to William Romy's framework. These images comprised drawings, charts, photographs, and other visual materials related to the instructional content. Using William Romy's engagement index, the images were classified into two categories: active and passive. The passive category (a) included images primarily used for further explanation and interpretation of the text, while the active category (b) consisted of images that prompted activities, questions, or student responses, as detailed in Table 4. The analysis revealed that out of the 10 images, 2 were active and 8 were passive. The engagement index was calculated using the following formula:

$$\text{Engagement Index} = \frac{2}{8} \approx 0.25$$

This low engagement index suggests that the instructional images in this section are mostly passive and have limited potential to stimulate critical thinking, interaction, or hands-on activities among students.

Table 4. Content Analysis of the Images in the Sixth Grade Science Textbook (Physics Section) Based on the Image Engagement Index

Categories / pages	Passive	active
	a	b
40	*	---
45	*	---
48	*	---
52	*	---
58	*	---
60	*	---
63	*	---
67	---	*
71	*	---
103	---	*
Total Passive Categories		Total Active Categories
8		2

0.25	Engagement Index

Final Summary and Statistical Conclusion

Based on the content analysis conducted using William Romi's method, Table 5 summarizes the engagement coefficients across three key components of the sixth-grade science textbook (Physics section): textual content, questions, and images. The text demonstrated the highest level of student engagement, with a coefficient of 1.2, indicating that the written content frequently prompts student activity, inquiry, or practical involvement. The engagement coefficient for the questions was 0.42, reflecting a moderate level of interactivity, while the images scored the lowest at 0.25, suggesting a largely passive visual presentation.

The overall mean engagement coefficient across all components was calculated to be 0.62, placing the textbook in the range of moderate engagement. This suggests that while the textbook succeeds in promoting active learning through its textual content, it falls short in utilizing images and questions to the same extent. These results highlight the potential for improving the visual and interrogative aspects of the textbook to foster deeper cognitive and practical engagement in students.

Table 5. Engagement Index of the Sixth Grade Science Textbook (Academic Year 2024–2025)

Textbook	Average Engagement Index	Image Engagement Index	Question Engagement Index	Text Engagement Index
Sixth Grade Science Textbook (2024–25)	1.2	0.25	0.42	0.62

DISCUSSION AND CONCLUSION

Science education in the elementary years plays a crucial role in enhancing students' scientific thinking skills, problem-solving abilities, and fostering their interest in learning. Therefore, the content of textbooks at this stage should be designed to actively engage students in the teaching-learning process. This study analyzed the cognitive engagement of sixth-grade physics content in the 2024 edition of the elementary science textbook using William Romi's method. The findings revealed that the engagement coefficient for the text was 1.2, indicating active written content, while the engagement coefficient for questions was 0.42, suggesting borderline activity that requires further improvement. However, the engagement coefficient for images was 0.25, demonstrating inactivity. The overall average engagement coefficient was 0.62, reflecting a moderate level of student engagement.

These results align with previous studies, such as Chandool [13], who found similar patterns of active text but inactive images and questions in fourth-grade science textbooks, highlighting a recurring issue at the elementary level that demands attention. In contrast, Atabak et al. [16] reported higher engagement coefficients across text, images, and questions in a sixth-grade science textbook, which may be due to differences

in publication year, scope, and analytical approach. Similarly, Ramzani and Dashti [12] evaluated the entire sixth-grade science textbook (2019 edition) and reported higher image engagement, possibly due to the comprehensive nature of their study and updates made in the 2024 edition analyzed here. Ahmadi et al. [14] also emphasized the relative activity of biological content and images in fifth and sixth-grade science books but acknowledged a gap from optimal standards. Moreover, the perspectives of Nourian [11] and Sharafi et al. [9] underline the importance of increased imagery in lower grades and the essential role of hands-on activities, highlighting the need for content design that aligns with developmental and pedagogical considerations.
Accordingly, to improve learning quality and promote active student participation, it is recommended that educational images be designed not only to illustrate scientific concepts but also to encourage analysis, comparison, and inference. Questions should be revised to target higher-order cognitive skills beyond mere recall. Teacher training should emphasize active teaching strategies, and a comprehensive teacher's guide based on active learning principles should be developed. Additionally, periodic content revisions aligned with global scientific advances and successful international educational practices are essential. Implementing these measures can significantly enhance the teaching-learning process and improve educational outcomes in elementary science education.

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