# Descriptive Analysis of the Graphical Representations of Cycle-2 Primary Science Textbooks in Bahrain

<sup>1</sup>Faten S. M. Abdel-Hameed, <sup>2</sup>Salah A.A. Emara <sup>1</sup>Bahrain Teachers College, University of Bahrain <sup>2</sup>Studies and Research Unit, University College of Bahrain

### Abstract

Educational reform documents and research papers in the field emphasize the crucial role of analyzing the contents of science textbooks in improving science education. The broad objective of our critical review is to explore the effectiveness of Cycle-2 Primary Science textbooks and workbooks in terms of their reflection of the Bahrain Ministry of Education's school and curriculum reforms. The readability level, gender distribution, questioning cognitive levels and location, and graphical representations of concepts are examined. The purpose of this paper (part I of the review) is to quantify the type, quality and pedagogical functions of the graphical representations of the newly developed Cycle-2 primary science textbooks and the accompanying workbooks. Twelve Science textbooks and workbooks were examined using an authordeveloped graphical analysis grid. Descriptive statistical analysis was performed. Results show that the least analytic form of graphics dominated. There was an absence of maps and scale diagrams and most of the graphs were of static nature. Analysis also showed that indigenous graphics were dominant over foreign graphics. More than one third of the graphics served a specific cognitive function and were connected to the text, and most of them were captioned and indexed. Further research is undergoing to establish a connection between graphical representations and students' achievements and attitudes towards science.

# **1. Introduction**

Science educators agree that textbooks play an important role in the teaching and learning processes [6], [7], [11]. Numerous research studies have been conducted on science textbooks analysis in the past several decades. Since textbooks are being used as a major source of information in teaching a particular subject, the quality and accuracy of the content is crucial for their educational effectiveness.

International organizations, such as the UNESCO formulated comprehensive strategies and guidelines on textbook research. In the UNESCO guidebook, Pingel [14] provided criteria for analyzing texts and modes of presentations; such as the use of illustrations, photos, maps, and tables and exercises. The American Association for the Advancement of Science, (AAAS) Project 2061, developed an analysis protocols to evaluate the instructional effectiveness of science textbooks.

In analyzing the science textbooks researchers look into the balance between theoretical and practical knowledge, portrayal of minorities, women and gender fairness, treatment of socio-scientific and controversial issues, and depiction of graphical information, vocabulary load, comprehensibility and readability at intended level, accuracy and coherence, representation of indigenous knowledge, the role of textbook questions, dealing with and misconceptions, cultural and religious sensibility. A number of analytical tools have been constructed in recent years in the form of survey questionnaire, rubrics, grids, criteria, rating scheme and procedures using ethnographic content and reflexive document analyses, coding of the indicators, and image analysis protocols.

Slough et al [15] conducted a study to quantify the type and quality of the graphical representations and how they interacted with the textual material in middle school science texts in the United States. The team analyzed state approved sixth-grade science textbooks to determine the use of graphical representations in the books. They used purposely developed research instrument Graphical Analysis Protocol (GAP). The GAP was designed to identify and analyze the type and quality of the graphical representations and how they interacted with the textual material in the science texts. They reported that analytic forms of graphics were dominated in the text and one third of all graphics were decorative in nature, most graphics were static, and approximately one third were not connected to the text spatially or semantically and reasons for optimism.

In most cases, science textbooks originate in the western countries and they are adapted by others in different geographical regions and culture. Textbooks developed in western countries are primarily to serve their own education system and tend to carry western perspectives and culture (Aikenhead, [2]). Ninnes [13] stated the need to embrace indigenous knowledge and local culture of the society if we were to make these textbooks effective in their own contexts.

In Turkey, Irez [9] assessed five secondary school biology textbooks and examined the nature and the

quality of treatment given to the nature of science. The author noted that there were serious problems with the way nature of science is portrayed in the textbooks. It was found that science was portrayed as collection of facts instead of a dynamic process of generating and testing alternative explanations about the nature.

In an attempt to determine the characteristics of the Nature of Science explained in the textbooks, Guisasola et al [8] examined 30 titles of university level Physics books that present the introduction of the concept and theories of magnetic field. They proposed that the textbooks can illustrate the characteristics of the Nature of Science by focusing on problems and change in the development of the theory of magnetic field.

Chiappetta and Fillman [5] analyzed the high school biology textbooks for inclusion of four aspects of the nature of science: (i) science as a body of knowledge, (ii) science as a way of investigating, (iii) science as a way of thinking, and (iv) science and its interactions with technology and society. They reported that the five recently published biology textbooks have a better balance of presenting biology with respect to the four themes of science literacy as compared to the textbooks that were used 15 years ago.

According to Lee [12], visual representations are commonly found in science textbooks and how they have been used is the focus of discussion among educators. The author examined the extent to which changes in representations in textbooks published in the US over the past six decades. It was found that high-fidelity images, such as photographs are more often used than the schematic and explanatory images to promote the familiarization to students.

Ajda Kahveci [10] quantitatively analyzed the effectiveness of Turkish chemistry and science textbooks. The author applied content analysis procedure to investigate gender equity, questioning level, science vocabulary load, and readability level and concluded that the textbooks included unfair gender representations, a considerably higher number of input-level and processing than output level questions, and high load of science terminology.

# 2. Rationale and Purpose of the Study

As part of the Bahrain Educational reform ourselves, we needed to perform this whole critical review of cycle-2 primary science textbooks and workbooks in order to reflect on how they are aligned with the principles and standards of the science curriculum reform and with the guiding principles of the Bahrain MOE education reform as a whole. This study is considered of a benefit to curriculum developers and teachers in producing reform-oriented science textbooks, which would help in improving the quality of science textbooks used in Bahrain.

Textbook quality has been correlated directly and indirectly to the success of education reforms and to the enhancement of students' understanding, Chambliss and Calfee [4]; Koppal and Caldwell [11]; Chiappetta and Fillman [5]; (Abd-El-Khalick et al., [1]). Well designed and written textbooks are shown to help students to understand the difficult concepts and overcoming scientific misconceptions. They are also expected to raise students' interests in learning science topics and eventually improve students' achievements in science.

The main objectives of the recently implemented MOE Educational and curriculum reform initiatives involve infusing constructivist principles, inquiry approach and higher order thinking skills to the teaching and learning of the science and mathematics, Bahrain Ministry of Education [3].

The following section will lay out the process of developing the science textbooks in Bahrain.

In this study, we utilize an authors' developed grid to quantitatively explore the type, function and quality of the graphical representations in cycle-2 primary science textbooks.

# **3.** Process of Developing Science Textbooks in Bahrain- Context of Study

The Ministry of Education Science and Mathematics curriculum development was triggered by results of the Trends in International Mathematics and Science Studies (TIMSS). As several other countries, the Kingdom of Bahrain was unsatisfied with these results. This fueled the attempts to reform school Science and Mathematics curricula (Chiappetta & Fillman, [5]).

A Science and Mathematics curriculum development team was formed. The team's job was to develop a new improved 1-12 Science and Mathematics curriculum that adopts inquiry and critical and creative thinking-based approaches. In order to make the new curricula work and bring all students to the level of understanding and skills proposed in the new Science curriculum, development included the content of textbooks, workbooks, teachers' instruction manuals as well as other learning and instructional materials.

The team started to examine various science and mathematics textbooks and accompanying materials from international publishing companies, looking for high quality learning materials in which the content addresses the ideas students are intended to learn, as described in the modified curriculum, and the instructional modes support effective teaching and student achievement of a learning goal. McGraw-Hill Science and Mathematics K-12 package was chosen.

A team of Science consultants and specialists performed, supervised and reviewed the adaptation

and alignment of the Arabic versions of all learning materials with the Bahraini curriculum, with the aid of Obeikan publishing of Saudi Arabia.

Science: A Closer Look, from McGraw-Hill Science for primary 4, 5 and 6 offers students' exciting and accessible standards-based lessons, engaging activities which promote curiosity and foster the development of science inquiry skills. Through a consistent and structured learning cycle (Engage, Explore, Explain, Evaluate and Elaborate), students confidently build upon their experiences to develop a lifelong understanding of science concepts in the following fields: Life sciences, Physical sciences, Earth sciences and Environmental sciences.

The adaptation and alignment of the McGraw-Hill Science learning materials followed a timeline. The first edition of cycle2 (primary 4, 5 and 6) science textbooks, workbooks, instruction manuals and other learning materials was published from 2009 to 2012 school years.

# 4. Methodology

### 4.1 Sample

The sample consisted of all Cycle 2 Science Students' Text-Books and Workbooks adopted in all government schools in the Kingdom of Bahrain that typically cover three years of instruction. Table 1 lists the titles that were covered in this study.

No	Level	Part	Title	Pages
1	Primary 4	Ι	Students' Text Book	158
2	Primary 4	Ι	Students' Work Book	50
3	Primary 4	II	Students' Text Book	146
4	Primary 4	II	Students' Work Book	43
5	Primary 5	Ι	Students' Text Book	150
6	Primary 5	Ι	Students' Work Book	62
7	Primary 5	II	Students' Text Book	156
8	Primary 5	II	Students' Work Book	63
9	Primary 6	Ι	Students' Text Book	158
10	Primary 6	Ι	Students' Work Book	54
11	Primary 6	Π	Students' Text Book	168
12	Primary 6	II	Students' Work Book	54

Table 1: List of textbooks under study

### 4.2 Research Tools

All graphics in the selected books were coded and analyzed with the researchers' developed Graphical Analysis grid. We looked for the graphs' form, function, topic area, quality, ethnic representation, gender representation, type and relation to text. Table 2 lists the categories of graphics with clear descriptions.

### Table 2: Graphic types with description

Graj	ph Type Description
I - Topic Area	
Plant	A plant photo or drawing of indigenous (local Arabic –from the Gulf – or Bahraini) or foreign origin (outside the Arabic world)
Animal	An animal photo or drawing of indigenous (local Arabic –from the Gulf – or Bahraini) or foreign origin (outside the Arabic world)
Human	A human photo or drawing, female or male
Environmental Science	An environmental photo or drawing of indigenous (local Arabic –from the Gulf – or Bahraini) or foreign origin (outside the Arabic world)
General	A general-science photo or drawing of indigenous (local Arabic –from the Gulf – or Bahraini) or foreign origin (outside the Arabic world)
Earth Science	An earth science photo or drawing of indigenous (local Arabic –from the Gulf – or Bahraini) or foreign origin (outside the Arab world)
Physical Science	A chemistry or physics photo or drawing of indigenous (local Arabic –from the Gulf – or Bahraini) or foreign origin (outside the Arabic world)
II – Form	
Photograph	Photograph only
Drawing	All features are shown in details
Map	Geographical features with spatial relation to other objects
Table	Cells, rows and columns
Flow chart	Arrows or numbers indicating stages
Graph	Relationships, statistical bar or pie graphs,
III - Ethnic repre	esentation
Indigenous	Local photograph (gulf states or Arabic)or drawing
Foreign	Non-local photograph or drawing
IV - Gender repr	resentation
Female	Female human photograph or drawing
Male	Male human photograph or drawing
V- Indexing	
None	Photograph or drawing is not mentioned in text
indexed	Photograph or drawing is mentioned in text
VI- Captioning	
No caption	No title or description under graph or drawing
captioned	A title or description is written under graph or drawing
VII- Quality	
Dynamic	Use series of images to show change over time in graph or drawing
static	No change with time in graph or drawing
VIII- Function	
Decorative	Does not support text, if taken out does not cause any difference in understanding of the written text
Related to Text	Important to text written, if taken out will affect understanding of text

### 4.3 Analysis Procedures

Following the development of the graphical analysis instrument, a coding key was used to establish a common understanding among the researchers. The data for each category were tabulated for each chapter in each textbook and workbook on a paper matrix. The data were then entered into an excel file and descriptive statistics for each variable were calculated.

The grid was validated by two science education specialists. In order to enhance the validity and reliability of the analysis procedure, two well experienced science curriculum specialists helped in performing the initial classification of the graphical representations, then the main author reviewed and re-entered the data into the excel grid for descriptive statistical calculations.

### 5. Results and Data Interpretation

In the following section, overall statistics regarding the number of pages and graphics analyzed, as well as results by research question according to the overall categories of: form, function, quality, ethnic representation and gender representation are reported for every grade level of cycle2's science texts and workbooks.

About 2,400 graphical representations were analyzed in the 12- textbooks and workbooks (two parts for every grade level). Illustrations covering all science topic areas were examined to answer the first research question in this study;

# (1)What are the frequencies of the graphics among the science topic areas?

As shown in Table 3, for grade 4 students' text books: 42% of the graphics covered life sciences, followed by 19% for physical sciences, 16% for general sciences, 13% for environmental science and 3% for earth science. The largest percentage of graphics covered life sciences, as it is the most common topic area in this age and grade level. For grade 4 work books, life sciences graphics represented the highest percentages (36%), followed by physical science (28%), then general science (25%) and environmental sciences (1.5%), and earth sciences came last with a percentage of (0.5%). For grade 5 students' text books, the same trend was found, as shown in Table 3, with 38% of the graphics covering life sciences, 24% physical sciences, 18.5% general sciences, 13% environmental science and 6%

earth sciences. For grade 5 work books, the trend was as follows: 36.5% of the graphics covered physical sciences, 28.5% general sciences, 28% life sciences, 4% environmental science and 3% earth sciences. Finally, for grade 6 students' text books: 40% of the graphics covered physical sciences, 32% life sciences, 14.5% general sciences, 10.5% environmental science and 2.5% earth sciences. For grade 6 work books: 45% of the graphics covered physical sciences, 20% life sciences, 20% general sciences, 32% earth sciences, 10% environmental science and 3% earth sciences.

Table 3: Frequencies of graphics in various topic areas for Cycle-2 primary Science textbooks and workbooks

					То	pic Area					
Grade	Lif Scier (Plar Anim Hum	fe nces nt + nal + nan)	Physical Sciences		Earth	Sciences	Env Scie	iron ence	General		
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
4	262	42	118	19	20	3	78	13	100	16	
textbook											
4	72	36	56	28	1	0.5	3	1.5	50	25	
workbook											
5	203	38	129	24	30	6	73	13	100	18.5	
textbook											
5	49	28	64	36	5	3	7	4	50	28.5	
workbook											
6	221	32	271	40	17	2.5	73	10.5	100	14.5	
textbook											
6	45	20	100	45	0	0	0	0	76	34	
workbook											
Total	852	36	738	31	73	3	234	10	476	20	
m			1		1		•		•		

To answer the second research question:

# (2)What is the distribution of the various forms of graphical representations?

The graphics in the 12 cycle-2 primary textbooks and workbooks were examined and broken down to photographs, drawings, maps, tables, flow charts, graphs and hybrids, the results are shown in table 4 for grades 4, 5 and 6 textbooks, and in Table 5 for grades 4, 5, and 6 workbooks.

Results showed that: in grade 4 textbooks, both part I and II, photographs were the most common form of graphics at 96.5%, while drawings came second at 2.8%, hybrids at 0.5%, tables at 0.3%, flow charts at 0.2%, maps at 0% and graphs at 0%. In grade 4 work-books, both part I and II, photographs were the most common form of graphics at 95%, with tables at 4%, drawings at 1%, maps at 0%, flow charts at 0%, graphs at 0% and hybrids at 0%. In grade 5 textbooks, both part I and II, the same trend was observed, photographs were the most common form of graphics at 93%, with drawings at 5%, tables at 0.9%, flow chart at 0.4%, graphs at 0.2%, maps at 0% and hybrids at 0.4%. In grade 5 workbooks, both part I and II, photographs were the most common form of graphics at 93%, with tables at 6%, drawings at 0.5%, flow charts at 0.5%, maps at 0%, graphs and hybrids at 0%. In grade 6 textbooks, both part I and II, photographs were the most common form of graphics at 90%, with drawings at 6%, tables at 2%, maps at 1%, flow charts at 0.3%, graphs at 0.3% and hybrids at 0.3%. In grade 6 work-books, both part I and II, photographs were the most common form of graphics at 89.5%, with drawings at 7.6%, tables at 3%, maps at 0%, flow charts at 0%, graphs at 0% and hybrids at 0%.

Table 4: Distribution of the forms of graphical representations for grades: 4, 5 and 6 textbooks

			Gra	ade			Tel	ual.
Form	4	1	!	5	6	5	10	di
	Fq	%	Freq	%	Freq	%	Freq	%
Photograph	578	96.5	511	93	640	90	1633	91.5
Drawing	17	2.8	27	5	44	6	88	7
Table	2	0.3	5	0.9	14	2	21	1.6
Мар	0	0	0	0	7	1	7	0
Flow chart	1	0.2	2	0.4	2	0.3	5	0.3
Graph	0	0	1	0.2	2	0.3	3	0.2
hybrid	3	0.5	2	0.4	2	0.3	7	0.4
Total	599	100	548	100	711	100	1764	100

Table 5: Distribution of the forms of graphical representations for grades: 4, 5 and 6 workbooks

			Gra	nde			_	
Form	4	ł		5		6	То	tal
	Fq	%	Fq	%	Fq	%	Fq	%
Photograph	199	95	174	93	187	89.5	578	90
Drawing	2	1	1	0.5	16	7.6	19	5
Table	8	4	11	6	6	3	25	4.6
Мар	1	0.5	1	0.5	0	0	2	0.3
Flow chart	0	0	0	0	0	0	0	0
Graph	0	0	0	0	0	0	0	0
hybrid	0	0	0	0	0	0	0	0
Total	210	100	187	100	209	100	624	100

The third question stated that:

(3) What is the distribution of the forms of graphical representations in the topic areas in the sampled

primary science textbooks and work-books for cycle2?

Summaries of the distribution results for this research question are given in Tables 6 and 7 for cycle-2 textbooks and workbooks respectively, which show that photographs dominate all topic areas in all grade levels.

### Table 6: Distribution of the forms of graphical representations in topic areas for grades 4, 5 and 6 textbooks: (a) Grade 4 textbooks

						Grae	de 4						
Form	Life Sciences		Physical Sciences		Ea Scie	Earth Sciences		Environment al Science		General		Total	
	Fq	%	Fq	%	Fq	%	Fq	%	Fq	%	Fq	%	
Photogr	254	97	110	93	20	100	78	100	96	96	587	97	
Drawing	8	3	8	7	0	0	0	0	4	4	17	3	
Total	262	100	118	100	20	100	78	100	100	100	604	100	

(b) Grade 5 textbooks

						Grad	e 5					
Form	Life Sc	iences	Physical Sciences		Earth Sciences		Environment al Science		General		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Photog	187	92	126	98	27	90	68	93	98	98	511	95
Draw.	16	8	3	2	3	10	5	7	2	2	27	5
Total	203	100	129	100	30	100	73	100	100	100	538	100

(c) Grade 6 textbooks

		Grade 6													
Form	Life So	ciences	Physical Sciences		Earth Sciences		Environment al Science		General		Total				
	Fq	%	Fq	%	Fq	%	Fq	%	Fq	%	Fq	%			
Photog.	196	89	255	94	36	100	67	92	96	96	659	94			
Drawing	25	11	16	6	0	0	6	8	4	4	44	6			
Total	221	100	271	100	36	100	73	100	100	100	703	100			

Table 7: Distribution of the forms of graphical representations in topic areas for grades 4,5 and 6 textbooks: (a) Grade 4 workbooks

						Gra	ie 4					
Form	Life So	ciences	Physical Sciences		Earth Sc	Earth Sciences		Environ Science		ral	Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Photog.	70	97	50	90	1	100	3	100	47	94	171	94
Drawing	2	3	6	10	0	0	0	0	3	6	11	6
Total	72	100	56	100	1	100	3	100	50	100	182	100

### (b) Grade 5 work-books

		Grade 5													
Form	Life S	sciences	Physical Sciences		Earth Sciences		Environm Science		General		Total				
	Fq %		Fq	%	Fq	%	Fq	%	Fq	%	Fq	%			
Photog.	49	100	60	94	5	0	7	100	47	94	168	96			
Draw	0	0	4	6	0	0	0	0	3	6	7	4			
Total	49	100	64	100	5	0	7	100	50	100	175	100			

		Grade 6													
Form	Life S	Sciences	Physical Sciences		Ea Scie	Earth Sciences		Environm Science		eral	Total				
	Fq	%	Fq	%	Fq	%	Fq	%	Fq	%	Fq	%			
Photog.	31	69	85	85	0	0	0	0	74	97	195	93			
Draw.	14	31	15	15	0	0	0	0	2	3	16	7.5			
Total	35	100	100	100	0	0	0	0	76	100	221	100			

### (c) Grade 3 work-books

The fourth question deals with the gender representations:

(4) What is the distribution of the gender representations of graphics in the sampled primary science textbooks and work-books for cycle2?

The answer to the above question is summarized in Table 8, which shows that male representations dominated both photographs (70% of grade 4 textbooks, 83% of grade 4 workbooks, 82% of grade 5 textbooks, 50% of grade 5 workbooks, 82% of grade 6 textbooks and 64% of grade 6 workbooks) and drawings (10% of all grade levels).

# Table 8: Distribution of the gender representations of graphics for grades 4, 5 and 6 textbooks and work-books

		Ger	nder				
Grade	Pho	tograph	Drawing				
	M*	F**	M*	F**			
4 (textbook)	72	24	1	0			
5 (textbook)	59	12	1	0			
6 (textbook)	107	24	1	0			
4 (workbook)	9	9	1	0			
5 (workbook)	23	5	1	0			
6 (workbook)	29	16	1	0			

\* M= Male, \*\* F = Female

Question 5 stated that:

(5) What was the ethnic representation (indigenous, foreign) of the graphics in the newly developed cycle-2 primary science textbooks and workbooks?

Ethnic representation data for both research questions are given in tables 9 and 10 for cycle-2

primary science textbooks and workbooks, respectively. We can see that the indigenous graphics dominated all grade levels in all topics, making 60% of the photographs and 72% of the drawings.

Table 9: Distribution of ethnic representations in Grades 4, 5 and 6 textbooks

						0100	-														
		4				5				6			1	Tote	21						
Topic Area	Photo	graph	Dra	wing	Photo	ograph	Draw	ing	Photo	ograph	Dra	wing	Photo	og.	Drawing						
	I	F	I	F	I	F	I	F	I	F	I	F	I	F	I	F					
Life sci	139	115	5	3	69	117	14	2	66	142	7	6	274	3 7 6	6	1					
Phys sci	110	1	7	0	100	9	6	4	220	40	7	4	430	5	2 0	8					
Earth sci	19	1	0	0	11	16	3	0	4	13	0	0	34	3 0	3	0					
Envi Sci	24	54	0	0	16	52	5	0	10	57	0	6	50	1 6 3	5	6					
Gen	85	7	6	2	85	8	6	1	73	14	1	2	243	2 9	2 3	5					
Total	353	178	1 2	5	281	202	34	7	373	266	2 5	1 8	103 1	6 4 8	7 7	3 0					

Table 10: Distribution of ethnic representations in Grades 4, 5 and 6 workbooks (I= Indigenous, F = Foreign)

						Grad	e									
Topic		4				5				6				т	otal	
Area	Photo	graph	Dr	aw	Photo	graph	Dra	wing	Photo	graph	Dra	wing	Pho	otog	Dr	awing
	I	F	I	F	I	F	I	F	I	F	I	F	I	F	I	F
Life sci	48	22	2	0	22	27	0	0	16	29	0	0	8 6	7 8	2	0
Phys sci	41	5	5	5	44	5	1 0	5	66	14	1 0	1 0	1 5 1	2 4	2 5	20
Earth sci	1	0	0	0	5	0	0	0	0	0	0	0	6	0	0	0
Envi Sci	3	0	0	0	0	7	0	0	0	0	0	0	3	7	0	0
Gen	35	5	5	5	40	5	5	0	60	8	4	4	1 3 5	1 8	1 4	9
Total	12 7	32	1 2	1 0	111	44	1 5	5	14 2	51	1 4	1 4	3 8 1	1 2 7	4	29

The sixth research question stated that:

(6)What were the functions (decorative- doesn't support text, representational- illustrating a concept, organizational- places text within a greater scheme e.g. scale diagram, related to text) of the graphical representations in the newly developed cycle-2 primary science textbooks and workbooks?

The answer to that question is clear from table 11 and table 12, which show that the majority of the graphics were decorative in nature, while a small percentage were representational and organizational (related to text). It can also be seen from Tables 11 and 12 that the number of representational and organizational graphics increases as we go to higher grades. Table 11: Distribution of the functions of graphical representations for grades: 4, 5 and 6 textbooks

Function		4	-	5	6		1 otai		
	Freq	%	Freq	%	Freq	%	Freq	%	
Decorative	510	82	402	75	481	70	1393	76	
Representa- tional	61	10	82	15	114	16	257	14	
Organization al	51	8	54	10	89	13	194	10	
Total	622	100	538	100	684	100	1844	100	

Table 12: Distribution of the functions of graphical representations for grades: 4, 5 and 6 workbooks

			Grade				Tot   Freq   365   140   92   597	
Function	4		5			6		ai
	Freq	%	Freq	%	Fre q	%	Freq	%
Decorative	139	69	105	60	121	55	365	61
Representa- tional	35	17	38	22	67	30	140	23
Organizational	27	14	32	18	33	15	92	16
Total	201	100	175	100	221	100	597	100

# Regarding questions 7,

(7)What was the quality (dynamic, static) of the graphical representations in the newly developed cycle-2 primary science textbooks and workbooks?

As shown in Tables 13 and 14, the static graphics dominated in all grade levels and topic areas, with more in the lower grade levels.

Table 13: Distribution of the quality of graphical representations for grades: 4, 5 and 6 textbooks

				Total				
Quality	4		5		6		100	ai
	Freq	%	Freq	%	Freq	%	Freq	%
Static	502	81	411	76	494	72	1407	76
					1			
Dynamic	120	19	127	24	190	28	437	24
					1			
Total	622	100	538	100	684	100	1844	100
					1			

# Table 14: Distribution of the quality of graphical representations for grades: 4, 5 and 6 workbooks

		Grade								
Onality	4		5		6	í	Totai			
£,	Freq	%	Freq	%	Fre	%	Freq	%		
					q					
Static	171	85	138	79	167	76	476	82		
Dynamic	30	15	37	21	54	24	121	18		
Total	201	100	175	100	221	100	597	100		

The last research question in this study dealt with the indexing and captioning of the graphics in various grade levels;

(8)What was the connection of the graphics, in the newly developed cycle-2 primary science textbooks and workbooks, to the written text (indexing, captioning)?

Tables 15 and 16, show the data regarding the connection of the graphics to the written text (indexing, captioning) in the newly developed cycle-2 primary science textbooks and workbooks, respectively. We can see that, 88% of the graphics are captioned and 95% of them are indexed.

### Table 15: Distribution of the indexing and captioning of graphics in grades 4, 5 and 6 cycle-2 primary science textbooks

Indexing and Cantioning	4		5		6		1 otai		
Cuptioning	Frequency	%	Frequency	%	Frequency	%	Frequency	%	
Indexed	525	84	485	9 0	597	87	1607	87	
Not-indexed	97	16	53	1 0	87	13	237	13	
Captioned	591	95	508	9 4	618	90	1717	93	
Not-captioned	31	5	30	6	66	10	127	7	

Table 16: Distribution of the indexing and captioning of graphics in grades 4, 5 and 6 cycle-2 primary science workbooks

Indexing and	4		5		6		Total	
Captioning	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Indexed	181	90	154	8 8	198	89	533	89
Not-indexed	20	10	21	1 2	23	11	64	11
Captioned	192	95	168	9 6	213	96	573	96
Not-captioned	9	5	7	4	8	4	24	4

### 6. Discussion and Further Research

In this study, a descriptive statistical analysis of the type, function and quality of the graphical representations in 12-Bahrain cycle-2 primary science textbooks and workbooks was performed. The results of this study suggest that all graphic forms were represented. Most forms of graphics are represented across all from topic areas. About 70% of graphical representations are general, 36% belong to life science topic area, 10% to environmental science, 3% to earth science and 31% to physical science. Results also showed that less than one third of the graphics were of the more analytic forms; more than one third served a specific cognitive purpose; 39% were well connected to the text; 87% were indexically referenced. Two third of the graphics were decorative; 76% were static representations; 13% were not indexically referenced; and 7% did not have captions.

This summation shows that graphics were primarily added to the text to make it more appealing to the teachers and students. There was an absence of maps and scale diagrams. Analysis also showed that indigenous graphics represented about 65% while foreign graphics represented 35% of the total graphics. Male representations made 77% of the graphics, while female ones made 23% of them. Future work is underway, taking into account the gender equity issues, the readability level, the questioning levels and the scientific vocabulary loads. Research is being performed in order to the connection between graphical examine representations and students' achievements and attitudes toward science.

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