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Analysis of science textbooks as cultural supportive tools: the case of arab countries

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ABSTRACT

The purpose of this study was to investigate if science textbooks prepare students for the twenty-first-century and if and how science and religion are depicted in science textbooks in Arab countries where religion, especially Islam, plays a role in the lives of individuals and possibly in the understandings of science. The analysis was conducted within a cultural-historical theoretical framework that suggests that textbooks can be considered cultural products that have a significant cultural mission with a formative influence on the development of individuals and the cultural reproduction of society. Science textbooks of eight Arab countries were analyzed using a tool that included eleven questions focused on twenty-first-century knowledge and skills and if and how Islam is presented in the textbooks. The analysis shows that textbooks of Arab countries included in this study have the potential to prepare students for the twenty-first-century to some extent, as indicated by the identified knowledge and skills emphasized in the book. However, in the six countries whose textbooks included Quranic verses, these textbooks play a mediating cultural role in encouraging students to think and act with a religious context in addition to equipping them with twenty-first-century knowledge and skills.

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Within a cultural-historical theoretical framework, textbooks can be considered cultural products that have a significant cultural mission with a formative influence on the development of individuals and the cultural reproduction of society. They can be described as supportive cultural tools (Vygotsky, 1986) by which the 'process of cultural mediation of development proceeds' (Plut & Pešić, 2003, p. 503). Textbooks are complex cultural tools in which more specific cultural tools are built. Plut and Pešić (2003) assert that textbooks present codified systems of knowledge that educated members of a culture are expected to master and treat textbooks as powerful cultural tools that represent the means through which cultural mediation of development proceeds. According to Al-Murtadha and Feryok (2017, p. 236), 'Textbooks are perhaps one of the most potent means of mediation available for socializing youth into cultural and social expectations.' Consequently, analyzing textbooks may provide insights about the implicit and explicit 'messages' these

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textbooks send regarding the desired characteristics of students who graduate from an educational system.

There are currently significant efforts to enhance the quality of science teaching and learning in Arab countries because of the belief that science is one of the significant catalysts for development (Muasher & Brown, 2018). These efforts include the development of science curricula and textbooks - among many other tools. Presently, science textbooks are still considered the major resources for teaching in Arab countries (Aldahmash et al., 2016) and are essential tools with which teachers help students accomplish the goals and objectives of standards and curricula. Likewise, because of considering them as supportive cultural tools, textbooks may express other goals and messages about how science is viewed within a culture in which religion, especially Islam, plays a central role in the lives of individuals.

Concurrently, Arab students living in the twenty-first-century are expected to graduate from schools and universities with knowledge and skills that prepare them to live productive lives in this Century. In the absence of attempts to identify the needs of Arab students for successful living and working in the twenty-first-century, attempts to do so in Western societies were adopted in this paper. Several organisations, such as the Partnership for twenty-first-Century Skills (P21) and the Organization for Economic Cooperation and Development (OECD[1]) have identified this knowledge and skills, and developed frameworks that detail the competencies needed by students. However, it is not clear whether twenty-first-century knowledge and skills are incorporated into science textbooks. Additionally, the cultural context in which students are learning these skills, especially the religious context, is an essential factor that has not been investigated about teaching and learning science even though there are possible interrelationships between science and religious beliefs. According to Nord (1999), the 'relationship of religion and science is much more complicated, much more interesting, and much more important than most educators suspect given the usual, superficial debate about evolution and creationism' (p. 55). While defining the nature of this relationship has been debated in intellectual circles, this topic has been ignored in many curricula and textbooks (Nord, 1999).

A review of research on the inclusions of the twenty-first-century skills in science textbooks in Arab countries did not result in studies on the topic. One of the few studies that investigated a related topic was conducted by Aldahmash et al. (2016). This study aimed to investigate the inclusion of the essential features of scientific inquiry in Saudi Arabian middle school science textbooks by using the scientific inquiry 'essential features' rubric. Results showed that these features were included in 59% of the analyzed activities. There is even less research on the way Islam is integrated into science textbooks. For example, Asghar et al. (2010) analyzed the national secondary-level science curriculum and biology textbooks used in the government schools in Pakistan, a majority Muslim country, to determine how the theory of evolution was presented in these textbooks. Results showed that both the religious and scientific texts are presented in the textbook when evolution is discussed. Specifically, relevant Quranic verses about creation are presented alongside the scientific evidence supporting evolution. Including Quranic verses, according to Asghar et al. (2010), was done to show that evolution and the Quran, and consequently, Islam, were compatible. In another study, Asghar et al. (2014) investigated the status and the treatment of the theory of evolution in secondary level textbooks of five Islamic majority countries (Egypt, Malaysia, Syria, Turkey, and Pakistan). Results showed

that evolution was included in the science curricula of all these countries. However, these curricula did not include a detailed discussion of human evolution. Moreover, Pakistan was the only country in which there was a reference to religion when discussing evolution. An extensive literature search showed that Hasaniyah (2016) published the only paper on a related topic in an Arab country. This study involved analyzing Grades 1–12 Jordanian science textbooks using a framework that was based on the explanation of Ibn Kather of the Quran. Results showed that 5% of the Quranic verses used in the textbooks were aligned with the contents of the lessons, while 11% agreed partially, and 84% did not agree.

The absence of research on science textbooks as supportive cultural tools makes it necessary to investigate whether science textbooks prepare students for the twenty-first-century, and if and how science and religion are depicted in science textbooks in Arab countries whose populations are mostly Muslim, and where religion plays a role in the lives of individuals and possibly in the understandings of science (Author 1 et al.). Specifically, this study attempted to answer the following question: To what extent do science textbooks in Arab countries emphasize twenty-first-century skills, and how do these textbooks represent religion concerning science?

After introducing the twenty-first-century skills as conceptualised by P21 and OECD, we introduce a tool that was used to analyze science textbooks based on the twenty-first-century skills along with how religion is incorporated in these textbooks. We then present the results of analyzing textbooks used in eight Arab countries: Bahrain, Egypt, Iraq, Jordan, Kuwait, Oman, Saudi Arabia, and Sudan.

Partnership for twenty-first-century skills (P21)

P21 (2009)[2] outlines learning outcomes that specify the knowledge, skills, expertise, and literacies needed for success in work and life. These include the core subjects of science, along with a set of twenty-first-century interdisciplinary themes that result in higher-level learning and the ability to deal with twenty-first-century science-related issues. These themes include global awareness, financial, economic, business, and entrepreneurial literacies, and civic, health, and environmental literacies.[3] Global Awareness requires that students use twenty-first-century skills to appreciate and address global issues, learn from and collaborate with individuals from diverse cultures, regions, and backgrounds with respect and a spirit of open dialogue, and value the contributions of diverse cultures and languages. Financial, Economic, Business and Entrepreneurial Literacy requires that students know how to make personal economic and financial decisions, understand the critical role of the economy in society, and utilise entrepreneurial skills to increase productivity and career options. Civic Literacy requires that students participate effectively in their countries' political system to demand equality for all, personal freedoms, and the free flow of information. In addition, Civic literacy requires that students exercise the rights and obligations of citizenship at all levels and appreciate the implications of civic decisions on the lives of individuals and the local, regional, and global levels. Health Literacy requires that students understand basic health information and the available health services, and use this information in ways that enhance health and well-being, and prepare the individual to take the appropriate health decisions regarding proper diet, avoidance of danger and risk, and

reducing harmful stress. Finally, health literacy also requires that students understand current health issues and threats at the local and global levels. Environmental Literacy requires that students understand the environment and the conditions affecting it, and appreciate the importance of caring for the environment, and the impact humans and their activities have on the natural world. Furthermore, environmental literacy requires that students can analyze environmental issues, come up with possible solutions, and implement those solutions in collaboration with others.

The P21 framework categorises the skills into three types, (a) learning and innovation, (b) information, media, and technology literacies, and (c) life and career skills. Learning and Innovation skills include the four C's: Creativity and innovation, critical thinking and problem solving, communication, and collaboration. Information, media, and technology skills include information literacy, media literacy, and ICT (Information, Communications, and Technology) literacy. Life and career skills include flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, and leadership and responsibility.

OECD's key competencies for the twenty-first century

In 2005[4] OECD defined the competencies needed for a successful life and a well-functioning twenty-first-century society. Similar to the Partnership for twenty-first-Century Skills, the aim of the competencies identified by OECD aimed to boost productivity and market competitiveness, reduce unemployment through developing an 'adaptive and qualified labor' force, and create an environment for innovation in a world dominated by global competition. The societal aims of defining competencies included increasing individual participation in democratic institutions, social cohesion and justice, and strengthening human rights and autonomy as counterweights to increasing global inequality of opportunities and increasing individual marginalisation.[5]

OECD's conceptual framework for key competencies classified these competencies into three broad categories. First, individuals need to be able to use a wide range of tools for interacting effectively with the environment, both physical ones such as information technology and socio-cultural ones such as the use of language. They need to understand such tools well enough to adapt them for their purposes. Second, in an increasingly interdependent world, individuals need to be able to engage with others of different backgrounds autonomously. Third, individuals need to be able to take responsibility for managing their own lives and situating their lives in the broader social context, and act autonomously (p. 5). Central to this framework is the ability of individuals to be reflective, a skill that involves the ability to deal with change effectively, learn from experience, and take a critical stance toward issues. This position requires establishing an appropriate learning environment and assumes that individuals go beyond what they learn in school and be dynamic and responsive actors in society. The three broad competency categories include[6]: Competency Category 1: Using Tools Interactively. The social and professional demands of the global economy and the information society require mastery of socio-cultural tools for interacting with knowledge, such as language, information, and knowledge, as well as physical tools such as computers. Competency Category 2: Interacting in Heterogeneous Groups. This competency focuses on the need of individuals to live and work with others in pluralistic societies in the currently globalised economies.

Furthermore, it requires individuals to relate well to others, cooperate and work in teams, and manage and resolve conflicts. Competency Category 3: Acting Autonomously. Acting autonomously does not mean functioning in social isolation but instead requires an awareness of one's environment, of social dynamics, and of the roles one plays and wants to play. It requires individuals to be empowered to manage their lives in meaningful and responsible ways by exercising control over their living and working conditions.

Tool for analyzing science textbooks (TAST)

TAST, whose structure and content can be seen in Table 1 was developed using an iterative process of refinement, testing, and discussions based on the skills identified in P21 and OECD. This tool is based on an instrument entitled 'Tool for Analyzing Science Standards and Curricula,' developed by Dani et al. (2013). TAST consists of 11 items distributed over the four sections of content, skills, additional curricular components, and references to Islam. The section on content includes two sub-items: science content and twenty-first-century themes. Content knowledge consists of the unifying concepts and processes of science, physical science, life science, earth and space science, understandings about scientific inquiry, understandings about science and technology, science in the personal and social perspectives, and the history and nature of science. Twenty-first Century Themes include environmental literacy, global awareness, economic literacy, civic literacy, and health literacy. The final section of the tool focuses on identifying references to Islam and religion in general in the chapter.

Methods

This section includes the textbooks and chapters that were analyzed, aspects of the chapters that were analyzed, the approach used to establish inter-rater reliability, and the data analysis procedures.

Textbooks and chapters that were analyzed

The following process was used to select chapters to be analyzed: 1) Between 5 and 7 science textbooks were purposefully selected from each country to include ones at the elementary (grades 1-6), intermediate (grades 7-9), and secondary (grades 10-12) levels, and that included general science, biology, chemistry, geology, and physics textbooks. Then, one chapter was randomly selected from each grade level textbook[7] by putting the chapter numbers of each book separately in a bowl and drawing one of the numbers. Consequently, 48 chapters were selected including, 13 biology, 11 chemistry, 9 physics, 10 general science, and 5 geology chapters. The number of geology chapters was small because not all countries had separate textbooks for geology. Moreover, the Saudi Arabian textbooks were at the secondary level because we did not have access to textbooks at the elementary and intermediate levels. Table 1 presents the titles of the chapters that were analyzed. It is to note that instead of analyzing all the textbook of one or two countries, we aimed to randomly select textbooks from different countries from the Arab region, specifically the Gulf (Bahrain, Kuwait, Oman, and Saudi Arabia), North Africa (Egypt and Sudan), and the Middle East (Jordan and Iraq). The rationale for selecting

Table 1. Titles of chapters that were analyzed.

Country	Chapter Title						
Bahrain	Science Grade 3	Science Science	Biology Grade 7	Physics Grade 9	Biology \Grade 10	Chemistry Grade 11	
Egypt	Science Digestive System (Grade 4)	You and science (Grade 5)	The atmosphere (Grade 8)	Chemistry Chemical reactions (Grade 9)	Digestion and nutrition in living things (Grade 11)	Chemistry Organic Chemistry (Grade 12)	
Iraq	Science Light and heat (Grade 3)	Science Aquatic plants (Grade 6)	Reaction and Chemical Equation (Grade 7)	Origin of Earth (Grade 11)	Physical Optics (Grade 12)		
Jordan	Movement and power (Grade 5)	Vibrations and waves (Grade 8)	Cells and their components (Grade 9)	External geological processes (Grade 9)	Oscillations and waves (Grade 10)	Sates of matter and molecular shapes (Grade 11)	
Kuwait	Animals (Grade 3)	Science and technology (Grade 6)	Cells and living things (Grade 7)	Chemical bonding (Grade 8)	Urinary system (Grade 9)	Atoms and chemical bonding (Grade 11)	Linear motion (Grade 12)
Oman	Organs and Systems of the Human Body (Grade 5)	Classification (Grade 6)	Use of Thermal Energy (Grade 8)	Matter & Energy in Chemical Reactions (Grade 10)	Immunity & Disease (Grade 11)	Electricity (Grade 12)	
Saudi Arabia	The Structure of the Atom (Grade 10)	Plant Structure and Function (Grade 10)	Organizing Life's Diversity (Grade 11)	Principles of Ecology (Grade 11)	Energy (Grade 12)	Redox Reactions (Grade 12)	
Sudan	Geology Grade 6	Biology Grade 7	Physics Grade 8	Biology Grade 9	Chemistry Grade 10	Physics Grade 11	

these countries was to identify the patterns in a cross-section of Arab countries that have different histories but similar cultural and religious backgrounds.

Aspects of the chapters that were analyzed

The guidelines for analyzing science textbooks were adapted from a document entitled 'Procedures for conducting content analysis of science textbooks' by Chiappetta and others (refer to Chiappetta et al., 1993; Chiappetta et al., 2006; Chiappetta, Fillman, et al., 1991; Chiappetta, Sethna, et al., 1991; Lee, 2007). According to these authors, the first step in textbook analysis involves finding the answer to the following question: Which aspects of a science textbook should one analyze for content messages? Chiappetta et al. (2004) suggest that the focus should be on paragraphs, questions, figures, captions, and pictures because they all serve to present a 'picture' of science. Each of these parts of a textbook is referred to as 'units of analysis.' Consequently, the following units were used to analyze science textbooks under consideration: 1) Complete paragraphs (not parts of paragraphs that have begun or ended on another page), 2) Questions, 3) Figures with captions (disregarding figures without captions), 4) Tables with captions, 5) Pictures with captions, 6) Marginal comments or definitions, 7) Each complete step of a laboratory or hands-on activity, and 8) Consider each step in a list of steps (such as a step in a procedure) or each paragraph as one unit of analysis. In addition to the above, any mention of Islam, such as Quranic verses, were considered units of analysis.

Chiappetta and Fillman (2007) identified the following aspects of textbooks not to be analyzed 1) A page with only one picture, even if accompanied by a caption or one or more paragraphs, 2) A page with fewer than two analyzable units, 3) Pages that contain only review questions, vocabulary words, etc., and 4) Goal and objective statements.

Reliability

Reliability was established through inter-rater agreement at the beginning of the textbook analysis and checked again at the end of the analysis. First, the three researchers, a senior science educator and researcher and two graduate students, met to discuss the analytical tool and ensure that they had a shared understanding of its components. During this process, they reviewed the components of the Partnerships for twenty-first-Century Skills and the Definition and Selection of Key Competencies published by OECD to orient themselves adequately for the analysis. Subsequently, in the first step of the analysis, the three researchers applied the tool to one life science chapter together to ensure that they had a common understanding of the tool. Then, in the second step, the two graduate students each analyzed one physical science and one biology chapter independently and met with the researcher to discuss the results and resolve any differences. Following this, the two graduate students analyzed one randomly selected chapter from each subject area (Biology, Chemistry, Earth science), independently, then met with the researcher to compare the results and resolve any differences until consensus was reached. Then each graduate student analyzed half of the rest of the chapters independently. The results of inter-rater agreements in the second step were: Physical science: $\alpha = 0.82$ and biology: $\alpha = 0.86$. In the third step, the reliabilities were as follows: Biology: α=0.90, Chemistry' α: 091, Earth science: 0.89.

Analysis procedures

Each of the chapters was analyzed separately using the TAST. Then, the results were used to develop a summary table of all the results by country (Table 2). The number of instances of each of the components of the TAST was transformed into percentages of the total number of instances in each country to enhance comparability.

Results

As expected, results show that science content was most prevalent in the textbook of the countries in this study. However, twenty-first-century themes such as environmental literacy, global awareness, economic literacy, civic literacy, and health literacy did not seem to be emphasized in all countries across the years and in all subject areas. They were instead introduced in specific chapters in the textbooks of two countries: Egypt and Iraq. Information skills were emphasized in all countries and at all educational levels. According to the twenty-first-century skills framework, information skills involve accessing, evaluating, using, and managing information.

Similarly, thinking and problem-solving skills were emphasized in the textbooks of all countries, but to varying degrees, with Bahrain and Saudi Arabia being the highest. According to the twenty-first-century skills framework, thinking and problem-solving skills involve reasoning effectively, using systems thinking, making judgments and decisions, and solving problems. Likewise, reflective skills were emphasized in the textbooks of all countries except Egypt. According to OECD, reflection is a skill that involves the ability to deal with change effectively, learn from experience, and take a critical stance toward issues.

Learning in a twenty-first-century context was emphasized in the textbooks of all countries, with Bahrain, Egypt, and Oman being the highest. According to the twenty-first-century skills framework, this involves learning academic content through real-world examples, applications, and experiences. Additionally, there are a few instances where creativity and innovation were emphasized in the Bahraini, Jordanian, Kuwaiti, Omani, Saudi Arabian, and Sudanese textbooks. Conversely, autonomy and self-directional skills, accounting for students' ways of knowing, teaching twenty-first-century themes, an assessment that utilises tools appropriate for twenty-first-century knowledge and skills, and emphasizing the use of technological tools seemed to be absent from the textbooks.

References to Islam were found in the textbooks of Bahrain, Jordan, Kuwait, Oman, Saudi Arabia, and Sudan. The appendix presents all these references, which involved including Quranic verses. This appendix shows that references to Islamic ideas were most prominent in Sudan. These references took different forms. Quranic verses were presented at the beginning of the chapters (Table 3), integrated into the chapters (table 4), and as question prompts in some of the chapters (Table 5). In addition, there were instances where scientific ideas were supported by using religion, Islam, in this case (Table 6). The Quranic verses used in these chapters contained ideas that were related to the content of the chapters but were not used to explain or clarify concepts in the chapters.

Table 3 above provides examples of Quranic verses that were placed at the beginning of the chapters and included ideas that corresponded to the content of these chapters. These

Table 2. Summary Results of Textbook Analysis Using the TAST.

Content	Bahrain	Egypt	Iraq	Jordan	Kuwait	Oman	Saudi Arabia	Sudan
	%	%	%	%	%	%	%	%
1. Helping students understand core academic content at high levels								
a. Science Content	35.9	59.6	63.3	45.5	62.6	46.8	44.3	46.8
a. twenty-first-century Themes (Environmental literacy, global awareness, economic literacy, civic literacy, and health literacy)	0	0.2	3.1	0	0	0	0	0
Skills								
2. Developing information skills	24.6	17.2	16.1	29.2	16.3	24.2	28.0	24.2
3. Developing communication skills	0.3	2.5	0.5	1.0	0.8	0.9	0.9	0.9
4. Developing creativity and innovation skills	0.5	0	0	0.3	0.5	1.0	0.5	1.0
5. Developing thinking and problem-solving skills	6.9	2.3	1.9	3.6	2.1	3.9	6.6	3.9
6. Developing reflective skills	9.3	0	1.7	9.0	4.1	6.3	5.7	6.3
7. Developing autonomy and self-directional skills	0	0	0	0	0	0	0.2	
Other								
8. Teaching and learning activities involve a twenty first century context (learning academic content through real-world examples, applications and experiences)	19.6	18.2	13.0	9.8	12.4	15.7	11.0	15.7
9. Assessment seems to use appropriate tools and approaches to measure students' performance on twenty-first-century content and skills.	0	0	0	0	0	0	0	0
10. Textbook authors consider the fact that students think and process information differently from their predecessors (accounting for students' ways of knowing)	0	0	0	0	0	0	0	0
a. Students are perceived as active learners (learning theories)	0.2	0	0	0	0	0	0	0
b. textbook supports a rich technological environment (availability of rich graphics and interaction with technological tools and media)	0	0	0	0	0.9	0.4	1.7	0.4
c. Textbook affords utilisation of technological tools allowing for parallel processing	1.1	0	0	0	0	0	0.5	0
11. Reference to Islam	0.8	0	0	0.4	0.3	0.7	0.5	0.7
a. Provides Quranic verses.								
b. Explains scientific knowledge using Islamic concepts								
c. Other								

verses seem to portray the message that the Quran should be considered as a foundation in learning and understanding (Loo, 2001).

In other instances, Quranic verses were integrated into chapters. Again these verses could have been used to show that scientific ideas could be 'derived' from the Quran. (Table 4). Importantly, these verses were placed strategically to correspond to specific ideas in the chapter rather than the content of the chapters.

Additionally, Quranic verses were used as question prompts (Table 5) apparently to encourage students to think about scientific ideas within an Islamic context. Finally, in a number of textbooks, there were places in which Islamic beliefs were used to support scientific ideas in the textbooks (Table 6).

Discussion

Results showed that science content was most prevalent in the science textbook of the countries in this study. It also showed that information skills, thinking and problem-solving skills, and learning in a twenty-first-century context are emphasized in the textbooks of all countries, while reflective skills are highlighted in the textbooks of all countries, except Egypt. Furthermore, creativity and innovation are emphasized in the textbooks of five countries in relatively low percentages, while autonomy and self-directional skills, accounting for students' ways of knowing, teaching twenty-first-century themes, assessments that utilise tools appropriate for twenty-first-century knowledge and skills, and the use of technological tools were almost absent from the textbooks.

These results suggest that textbooks are sending a message regarding the central importance of content, teaching this content in a twenty-first-century context in which students learn content through examples, applications, and real-world experiences both inside and outside school (Swandi et al. (2018)), and developing a number of skills associated with content such as thinking and problem-solving. This message is aligned with the overemphasis on the assessment of content in exit public examinations (end of secondary school) in most Arab countries (Colleague and Author 1). What is alarming, however, is that most of these state-administered exams focus on the ability to recall *traditional content* rather than on twenty-first-century themes and assessments that utilise tools appropriate for twenty-first-century knowledge and skills. Alternatively, emphasis on reflection in the science textbooks of several Arab countries, although limited in scope, can provide

Table 3. Quran verses presented at the beginning of chapters.

Country	Chapter	Quranic Verse
Bahrain	The earth is changing	When the earth is shaken with its [final] earthquake and the earth discharges its burdens, and man says, 'What is [wrong] with it? That day, it will report its news (Surah Al Zalzalah 1-4)
Jordan	Oscillations and waves	Or [they are] like darknesses within an unfathomable sea which is covered by waves, upon which are waves (Surah An-nur 40).
Kuwait	What are some types of Animals?	Allah has created every [living] creature from water. And of them are those that move on their bellies, and of them are those that walk on two legs, and of them are those that walk on four. Allah creates what He wills. Indeed, Allah is over all things competent (Surah An nur 45).
Oman	Human body	We have certainly created man in the best of stature (Surah At-tin 4)
Sudan	Resources	And He has subjected to you whatever is in the heavens and whatever is on the earth – all from Him. Indeed, in that are signs for a people who give thought (Sūrah Al-jāthiyah, 13)

Table 4. Quranic verses integrated into the chapters.

Country	Context	Quranic Verse
Saudi Arabia	Discussing the water cycle	And made from water every living thing? Then will they not believe (Surah al-Anbiya 30)
Saudi Arabia	Discussing classification	And there is no creature on [or within] the earth or bird that flies with its wings except [that they are] communities like you. We have not neglected in the Register a thing. Then unto their Lord, they will be gathered. (Surah Al-Ana'm 38)
Bahrain	Discussing density	Do you not see that ships sail through the sea by the favour of Allah that He may show you of His signs? Indeed, in that are signs for everyone patient and grateful (Surah Lokman 31).
Sudan	Discussing the atomic nucleus	But those who disbelieve say, 'The Hour will not come to us.' Say, 'Yes, by my Lord, it will surely come to you. [Allah is] the Knower of the unseen.' Not absent from Him is an atom's weight within the heavens or within the earth or [what is] smaller than that or greater, except that it is in a clear register (Surah Saba' 3).

students with the ability to deal with change effectively, learn from experience, and take a critical stance toward issues (OECD, 2005). Finally, the lack of emphasis on students' ways of knowing, autonomy and self-directional skills, the use of technological tools may alienate students from science because the textbooks are not providing them with the opportunities to develop as independent thinkers and use technological tools that are integral components of the lives of twenty-first-century students who were described by Prensky (2001) as digital natives. These findings suggest that there is a pressing need for responsible authorities in the countries whose textbooks were analyzed to develop plans to revise the textbooks so that they become effective tools to prepare students' to be successful in life and work in the twenty-first-century especially that research has shown that textbooks are still major sources of content in Arab countries (Aldahmash et al., 2016).

Quranic verses or references to Islam in several textbooks seem to play a mediating cultural role by encouraging students to think and act within a religious context while equipping them with some twenty-first-century knowledge and skills. What can be the purpose of including Quranic verses in the textbooks? First, it is possible that textbooks designers considered textbooks as tools that bridge science to the everyday life of students because most students in Arab countries live in cultural contexts that value Islam and religiosity (Abdel-Khalek, 2012, 2019; Musa, 2015). Another possible explanation is that the textbooks reflect the rules of conservative societies that consider the books as carriers of the

Table 5. Quranic verses used as question prompts.

Country	Context	Quranic verse
Jordan	Discussing chemical weathering	God said 'And We sent down iron, wherein is great military might and benefits for the people (Surah Hadid 40). Conduct research on the importance of iron, write a report and present it in (class)
Sudan	Discussing resources	Consider the meaning of the following verses and infer their relationships with resources: 1. And we placed therein gardens of palm trees and grapevines and caused to burst forth therefrom some springs that they may eat of His fruit. And their hands have not produced it, so will they not be grateful? (Surah Yasin 34 and 35) 2. Do they not see that We have created for them from what Our hands have made, grazing livestock, and [then] they are their owners? And We have tamed them for them, so some of them they ride, and some of them they eat (Surah Yasin 71 and 72)

Table 6. Examples of Supporting Scientific Ideas by Reference to Religion

Country	Context	Representation in the textbook
Sudan	Discussing sexually transmitted diseases	• To avoid the occurrence of these diseases (sexually transmitted diseases), religions prohibited unlawful sexual intercourse – adultery • How do you avoid infection with aids? Chastity and lack of sex outside the scope of marital legitimacy
Jordan	Discussing the importance of the atmosphere	God Almighty has given us a suitable environment to live on earth, and provided us with means of protection against all dangers, including what comes from outer space …
Bahrain	Discussing magnetism	Magnetism in animals: Bees, pigeons and other animals have special natural navigation tools. They use magnetism to find their way. Instead of a compass, God has provided these animals with small pieces of magnetite inside their bodies that they use to determine their paths by using the earth's magnetic field.
Saudi Arabia	Discussing recycling of matter	Energy is transformed into different forms … however; this does not apply to matter. The law of conservation of matter states that matter cannot be created or destroyed except by the will of God. Therefore, the vital processes in nature, with the intervention of God, recycle matter within the atmosphere

traditions, values, and norms of the country. Other purposes of including Quranic verses in science textbooks include the suggestion by Asghar et al. (2010) that including religious references alongside scientific evidence shows that science and religion are not in conflict. A final possible purpose is that educational authorities in the countries in which the textbooks are published are interested in accentuating the Islamic identities of countries through textbooks (Al-Murtadha & Feryok, 2017) or the Islamization of human knowledge (Hashim & Abdallah, 2013) because these textbooks could be the most effective means for socialising young people into cultural and social expectations.

A less discussed but important purpose of including Quranic verses in science textbooks can be to emphasize the 'miraculous scientific content' of the Quran known as *I'jaz,* the basic tenet of which is that the Quran is the source of all scientific knowledge which can be discovered through the interpretation of Quranic verses (Loo, 2001). Guessoum (2015) showed that the concept of 'miraculous scientific content' of the Quran is establishing a stronghold in the Arab countries through individuals such as El Naggar in Egypt. However, according to Guessoum (2015), a new generation of Muslim scientists who 'accept modern science's fundamental methodology, theories, and results, and try to find ways to 'harmonize' it with Islam' has appeared (p. 855) and are actively working on this harmonisation.

Textbooks as supportive cultural tools (Vygotsky, 1986) through which cultural mediation of development proceeds can play a significant role in improving the quality of science learning in Arab countries in the current context. This role can be augmented by carefully considering the needs of students to live productive lives in the twenty-first century and, at the same time, respecting the cultural context in which religion plays a significant role. Using religion as a bridge between science end everyday life or harmonising science with Islam Guessoum (2015), can be strong tools to improve the quality of science learning. The only unresolved and challenging issue is how can educational authorities in Arab countries with Islamic majorities in which verses from the Quran are included in science textbooks respect the rights of student religious minorities in these countries to have access to quality science education.

Notes

1. Refer to http://www.oecd.org
2. http://www.p21.org/storage/documents/1.__p21_framework_2-pager.pdf
3. Refer to https://files.eric.ed.gov/fulltext/ED519462.pdf
4. Refer to http://www.oecd.org/dataoecd/47/61/35070367.pdf
5. Refer to http://www.oecd.org/document/17/0,3343,en_2649_39263238_2669073_1_1_1_1,00.html
6. The descriptions of categories and subcategories are adapted from "The definition and selection of key competencies (http://www.oecd.org/dataoecd/47/61/35070367.pdf)".
7. One chapter from each of the following grades and topics were selected from Bahraini textbooks: G5 General Science, G7 Biology, G8 Chemistry, G9 Physics, G10 Biology, and G12 Physics.

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Appendix

Quran verses available in the analyzed chapters

Sudan	And He has subjected to you whatever is in the heavens and whatever is on the earth – all from Him. Indeed, in that are signs for a people who give thought. • Surah 34 Yasin And We placed therein gardens of palm trees and grapevines and caused to burst forth therefrom some springs • Surah 35 Yasin That they may eat of His fruit. And their hands have not produced it, so will they not be grateful? • Surah 71 Yasin Do they not see that We have created for them from what Our hands have made, grazing livestock, and [then] they are their owners? • Surah 72 Yasin And We have tamed them for them, so some of them they ride, and some of them they eat. Surah Saba 22 Say, [O Muhammad], 'Invoke those you claim [as deities] besides Allah .' They do not possess an atom's weight [of ability] in the heavens or on the earth, and they do not have therein any partnership [with Him], nor is there for Him from among them any assistant. • Surah Saba' 3 But those who disbelieve say, 'The Hour will not come to us.' Say, 'Yes, by my Lord, it will surely come to you. [Allah is] the Knower of the unseen.' Not absent from Him is an atom's weight within the heavens or within the earth or [what is] smaller than that or greater, except that it is in a clear register - • Surah Yunus 61 And, [O Muhammad], you are not [engaged] in any matter or recite any of the Qur'an and you [people] do not do any deed except that We are witness over you when you are involved in it. And not absent from your Lord is any [part] of an atom's weight within the earth or within the heaven or [anything] smaller than that or greater but that it is in a clear register. • Surah Al Zalzalah 1 When the earth is shaken with its [final] earthquake • Surah Al Zalzalah 2 And the earth discharges its burdens • Surah Al Zalzalah 3 And man says, 'What is [wrong] with it?' • Surah Al Zalzalah 4 That Day, it will report its news
Bahrain	Surah Nahl 11 He causes to grow for you thereby the crops, olives, palm trees, grapevines, and from all the fruits. Indeed, in that is a sign for a people who give thought. Surah An Naml 60 is He [not best] who created the heavens and the earth and sent down for you rain from the sky, causing to grow thereby gardens of joyful beauty which you could not [otherwise] have grown the trees thereof? Is there a deity with Allah? [No], but they are a people who ascribe equals [to Him]. Surah Loqman 31 Do you not see that ships sail through the sea by the favour of Allah that He may show you of His signs? Indeed, in that are signs for everyone patient and grateful. Suarh Al-Ana'm 38 And there is no creature on [or within] the earth or bird that flies with its wings except [that they are] communities like you. We have not neglected in the Register a thing. Then unto their Lord they will be gathered. • Surah Al-Mu'minun 12 And certainly did We create man from an extract of clay • Surah 13 Al-Mu'minun Then We placed him as a sperm-drop in a firm lodging. • Surah 14 Al-Mu'minun Then We made the sperm-drop into a clinging clot, and We made the clot into a lump [of flesh], and We made [from] the lump, bones, and We covered the bones with flesh; then We developed him into another creation. So blessed is Allah, the best of creatorsSurah 15 Al-Mu'minun Then indeed, after that you are to die. • Surah 16 Al-Mu'minun Then indeed you, on the Day of Resurrection, will be resurrected. Sural Ar-rum 54 Allah is the one who created you from weakness, then made after weakness strength, then made after strength weakness and white hair. He creates what He wills, and He is the Knowing, the Competent. Surah ar-ra'd 13 And the thunder exalts [Allah] with praise of Him – and the angels [as well] from fear of Him – and He sends thunderbolts and strikes therewith whom He wills while they dispute about Allah; and He is severe in assault. Surah ar-ra's 12 It is He who shows you lightening, [causing] fear and aspiration, and generates the heavy clouds
Saudi Arabia	Surah al Anbiya 30 and made from water every living thing? Then will they not believe Suarh Al-Ana'm 38 And there is no creature on [or within] the earth or bird that flies with its wings except [that they are] communities like you. We have not neglected in the Register a thing. Then unto their Lord they will be gathered.

	Surah An nur 45 Allah has created every [living] creature from water. And of them are those that move on their bellies, and of them are those that walk on two legs, and of them are those that walk on four. Allah creates what He wills. Indeed, Allah is over all things competent
Kuwait	Surah An nur 45 Allah has created every [living] creature from water. And of them are those that move on their bellies, and of them are those that walk on two legs, and of them are those that walk on four. Allah creates what He wills. Indeed, Allah is over all things competent.
	Surah al Anbiya 30 Have those who disbelieved not considered that the heavens and the earth were a joined entity, and We separated them and made from water every living thing? Then will they not believe?
Oman	Surah At-tin 4 We have certainly created man in the best of stature
	Surah Muminun 14 nd We covered the bones with flesh
	Surah An nur 45 Allah has created every [living] creature from water. And of them are those that move on their bellies, and of them are those that walk on two legs, and of them are those that walk on four. Allah creates what He wills. Indeed, Allah is over all things competent.
Jordan	Surah An-nur 40 Or [they are] like darknesses within an unfathomable sea which is covered by waves, upon which are waves
	Surah Hadid 40 And We sent down iron, wherein is great military might and benefits for the people,
	Surah Ghafir 82 Have they not travelled through the land and observed how was the end of those before them? They were more numerous than themselves and greater in strength and in impression on the land, but they were not availed by what they used to earn