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Representation of Science Process Skills in 5th Grade Science Textbooks in the United Arab Emirates

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Abstract:

Representation of science process skills in science textbooks' activities is essential and plays a significant role in pushing students toward balanced scientific knowledge. To ensure that science textbooks deliver what they were intended to provide, their scientific content must regularly be reviewed, analyzed, and evaluated. However, based on the literature, few scientific studies investigated the activities of integrated science textbooks approved and used by the Ministry of Education of the United Arab Emirates in light of a balanced representation of basic and integrated science process skills. Therefore, this study examines the level of the representation of basic and integrated science process skills in the inquiry activities of Emirati integrated science textbooks for fifth-grade students by using content analysis as a descriptive-analytical method. Content analysis is a multidimensional approach to understanding a text's different meanings or dimensions. The findings indicated that certain basic and integrated science process skills in the analyzed activities were better represented than others, such as measuring, using numbers, observing, and experimenting. The study discusses these findings in the context of the United Arab Emirates, and implications for teaching and learning and curriculum designers and developers are presented.

Keywords: content analysis, science process skills, Emirati science textbooks, Grade 5.

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Introduction

The primary goal of science education is assisting learners in combining their abilities, knowledge, and attitudes to comprehend scientific ideas (Derilo, 2019). In a world where knowledge is rapidly expanding, it is increasingly important to support students in developing skills that will aid them in formulating questions, gathering and organizing information, and reaching evidence-based conclusions. (Aydoğdu et al., 2014). Basic and integrated science process skills (SPS) are essential in learning and teaching science due to their role in scientific knowledge construction (Aljarallah, 2020) as well as the science booklets used by schools in Glasgow. A total of 31 scientific activities covered in the Saudi Arabian textbooks and 18 scientific activities covered in the Glasgow Science Program booklets were analysed according to a modification of Tamir and Lunetta's (1978).

The basic science process skills include skills such as observing, measuring, classifying, inferring, predicting, using numbers, using space-time relationships, and communicating (Aydoğdu et al., 2014). Observing is the skill that uses the student's senses to record events or objects during inquiry activities, as well as helps him to form new concepts about the nature of science (Maison et al., 2019). The measuring skill is the skill of quantifying observations and variables using different tools and standard and non-standard units (Köksal, 2008). The skill of organizing and arranging events or objects according to one or more characteristics is the skill of classification (Al-Shaeeli & Khataibeh, 2003). The skill of interpreting observations based on past experiences and knowledge is the inferring skill (Morris et al., 2015). In addition, the inferring skill helps students to understand scientific concepts better because it explains the variation in students' academic achievement (Alkhawaldeh, 2022). The predicting skill is "forecasting future events based on past observations or data extensions " (Inayah et al., 2020, p. 16).

The skill of using numbers is a skill that depends on the use of quantitative relationships such as precision, significant digits, error, and ratios (Köksal, 2008). The skill of using space-time relationships manipulates and visualizes events or things over time when dealing with shapes, speed, and time distance (Jahjouh, 2008). Communicating is the skill of sharing and presenting orally or in written format the results of investigations using several ways, such as words, symbols, graphs, and tables (Sideri & Skoumios, 2021).

On the other hand, integrated science process skills include skills such as defining operationally, hypothesizing, interpreting data, formulating models, controlling variables, and experimenting (Widyaningsih et al., 2020). The skill of defining operationally is the ability to correctly and accurately describe an event or object based on its series of operations (Köksal, 2008). The hypothesizing skill is stating temporary ideas for inference or observation that can be used after testing them to ensure their validity by conducting one or more experiments (Yang & Liu, 2016). Interpreting data is used to identify the underlying reasons for the data gathered or the phenomena observed according to prior knowledge (Jahjouh, 2008). The skill of controlling variables is identifying independent and dependent variables by manipulating and controlling the characteristics related to events and situations (Inayah et al., 2020). Formulating models involves "creating a mental or physical model of a process or event " (Sideri & Skoumios, 2021, p. 232). The experimenting skill is the ability to experiment by testing a hypothesis, controlling the independent variables, observing the change in the dependent variable, interpreting the results, and presenting them in the form of a report (Köksal, 2008). These skills are crucial not only for scientists but also for students to become scientifically literate (Harlen, 1999). It is essential therefore that these skills be included in science curricula and textbooks to help students acquire scientific knowledge and skills and develop self-learning (Jahjouh, 2008).

As science education is a national priority in the United Arab Emirates (UAE) (Tairab & Al-Naqbi, 2017), the Ministry of Education (MOE) strongly emphasizes integrating inquiry-based science teaching and learning into the science curricula of public schools (Al-Naqbi, 2015). The leadership of the UAE has developed seven wide-ranging goals for science education drawing upon the following: the nature of science; scientific processes; scientific inquiry; scientific knowledge; scientific literacy; scientific values, attitudes, habits, and dispositions of students and the interactions of science, technology, and society (Tairab & Al-Naqbi, 2017). Furthermore, goal seven aims to equip learners with the scientific skills necessary to promote opportunities for higher learning (Al-Naqbi, 2015).

For many teachers, the textbook is their go-to resource when organizing daily classroom activities and acts as the foundation for their decisions regarding what to teach and why (Alayasrah & Yahyaa, 2017). Based on data from the 2011 Trends in International Mathematics and Science Study (TIMSS) survey, the majority of grade 4 and 8 science teachers in the United Arab Emirates require students to read textbooks or other resource materials daily (IEA, 2011a, 2011b). Science textbooks generally include text-based content along with lab-based activities (Sideri & Skoumios, 2021). According to Overman et al. (2013), teachers frequently utilize these activities included in textbooks to gauge their students' progress and establish the key concepts they need to master. Therefore, evaluating these activities is of great importance because the quality of students' science learning is likely to be affected by the quality of the activities in their science textbooks.

As acquiring SPS in early grades of school is likely to contribute to students' intellectual and social abilities (Alayasrah & Yahyaa, 2017), primary school science textbooks should be designed to include activities that contribute to developing students' SPS. Since the fifth grade is the final year of primary school in the UAE, the work in this grade is crucial in developing the knowledge

and skills to become scientifically literate citizens, and incorporating scientific processes into the activities of science textbooks at this grade is fundamentally important. Hence, the purpose of this study was to examine the extent to which basic and integrated SPS are represented in inquiry activities that are included in Emirati science textbooks for fifth-grade students.

The acquisition of basic and integrated SPS is one of the main goals of science education. Therefore, this research seeks to draw the attention of science teachers and textbook writers to the importance of having representations of basic and integrated science process skills in Emirati science textbook activities. Furthermore, the study is significant in that it strives to draft recommendations that can be useful in developing and reviewing Emirati science curricula that adequately incorporate basic and integrated SPS.

Theoretical Background

Science process skills and science education

Science process skills are essential components of science and the cornerstone of scientific literacy (Yalçinkaya-Önder et al., 2022).

SPS are tools that enable us to solve problems in daily life. They significantly contribute to society's advancement (Aydoğdu et al., 2014) and are an integral part of science learning (Yalçinkaya-Önder et al., 2022). Furthermore, they equip students with necessary knowledge-building skills (Balfakih, 2010) and form the basis for scientific inquiry, literacy, and conceptual learning ability development (Al-Rabaani, 2014).

Several researchers agree that scientists' ability to use information to address issues and produce findings is related to what is known as intellectual ability, which is a demonstration of mental operations needed to construct knowledge or solve problems. These mental operations represent the SPS (Aljarallah, 2020; Özgelen, 2012; Sibic & Şeşen, 2022; Sideri & Skoumios, 2021). Other

researchers define SPS as the thinking abilities that individuals use to describe a problem, create knowledge, make predictions, formulate hypotheses, specify variables, present results, gather and analyze data, and test presumptions through experimentation (Aydın, 2013; Aydoğdu et al., 2014; Yalçinkaya-Önder et al., 2022). SPS are characterized as instruments people use to gather and organize information about the world (Aydoğdu et al., 2014). Moreover, Yalçinkaya-Önder et al. (2022) defined SPS as 'insights to develop the intellectual, social, and physical skills that are the source of the student's self' (p. 433). In addition, SPS make learning science easier, promote active learning and inquiry, make information more durable, and foster a sense of responsibility in learners (Maison et al., 2019). Therefore, these skills help equip students to handle issues, pursue independent learning, and understand science (Aljarallah, 2020).

Basic science process skills

The most fundamental abilities regularly employed in science are the basic SPS (Ozkan & Umdu Topsakal, 2021). Basic SPS, particularly in the elementary school years, pertain specifically to students' core cognitive functioning (Maison et al., 2019); they provide the intellectual underpinnings of scientific inquiry such as the skills to classify and describe phenomena in nature (Aziz & Zain, 2010) and the foundation for the acquisition and mastery of integrated SPS (Novitasari & Aminatun, 2021).

Integrated science process skills

Integrated SPS are essential components of scientific inquiry and literacy (Chokchai & Pimdee, 2019) that require a higher level of understanding than the basic SPS (Özgelen, 2012). For example, to conduct scientific investigations, learners need to have integrated SPS (Aziz & Zain, 2010). In addition, proficiency in integrated SPS will prepare learners for living and working in the 21st century, which calls for applying scientific knowledge and research (Chokchai & Pimdee, 2019).

Previous studies related to SPS and textbooks

Several researchers have examined whether contemporary science textbooks are adequately providing opportunities for students to acquire SPS (Aljarallah, 2020; Jahjouh, 2008; Ozkan & Umdu Topsakal, 2021; Yalçinkaya-Önder et al., 2022). For instance, Dökme (2005) assessed the SPS content in the activities of sixth-grade science textbooks published by the Turkish MOE and found varying levels of integration. For example, 89.06% of the lessons incorporated observing, and 64.06% included inferring. In contrast, only 14.06% of textbook activities incorporated predicting, 6.25% included classifying, and 1.56% involved formulating hypotheses. In response to these imbalanced findings, the researcher presented some recommendations, including increasing the integration of less common skills and increasing the number of activities in Turkish science textbooks or expanding the content of these activities.

Furthermore, Yumuşak (2016) aimed to ascertain the degree to which the SPS were covered in the Turkish science curriculum for third through eighth grades using document analysis. The author found that the same learning areas were presented in each grade level but that the repeated lessons in higher grades were more complicated and in-depth. Yumuşak (2016) concluded that SPS were substantially represented in the general purposes of the 2013 Turkish science curricula with a focus on basic rather than integrated skills.

Similarly, Ozkan and Umdu Topsakal (2021) analyzed the learning outcomes of Turkish science education curricula for fourth through eighth grades according to SPS. They used document analysis to analyze 269 learning outcomes and concluded that the science learning outcomes in the seventh grade were the highest and those in the fifth grade were the lowest. Further, they found that the skills of inference and data interpretation were the most commonly developed in the science learning outcomes in all grades, whereas hypotheses making and taking measurements were the least common; overall,

the authors found more evidence of integrated SPS than basic in the science learning activities except for the fourth grade.

Yalçinkaya-Önder et al. (2022) examined the degree to which the SPS was provided in Turkish science textbooks for the third through eighth grades using document analysis and identified 899 SPS represented in 42 units. The authors found that sixth-grade science textbooks encouraged students to practice more SPS and the third-grade textbooks provided the least encouragement; additionally, observation was the most frequently incorporated skill in all grades, and formulating models and using data were the least used skills.

Additionally, they concluded that the utilization of SPS in textbooks for sixth and seventh graders was above average when averages of those skills were compared to them, Although the use of SPS was seen to increase in primary school textbooks from the third to the fourth grade, this increase was not observed for secondary school textbooks.

On the other hand, Jahjouh (2008) investigated the extent to which basic and integrated SPS were represented in science textbooks for Grades 1–10 in Palestine using content analysis of 83 units from all science textbooks for the ten grades. He identified the following basic skills were incorporated into the Palestinian science textbooks, in descending order: observing (31%), communicating (25%), measuring (7%), inferring (5%), using numbers (4%), classifying (3%) and predicting (2%) (Jahjouh, 2008). He also identified the following integrated SPS: interpreting data (11%), experimenting (9.6%), controlling variables (2%), and formulating hypotheses (0.4%). He recommended giving more attention to the less-represented skills in scientific activities.

Moreover, the study of Aljarallah (2020) examined the integration of basic SPS in science textbook activities for the fourth grade in the Kingdom of Saudi Arabia (KSA) compared with the activities included in the booklet of the

Glasgow Science Program using content analysis. She analyzed, respectively, 31 and 18 activities included in the Saudi Arabian science textbook and Glasgow Science Program booklet and found that observation, measurement, and inference were more represented in the KSA textbook than in the Glasgow booklet; additionally, prediction and classification were represented at similar levels in both curricula but were represented much less frequently than the other skills. Further, Aljarallah (2020) found that the large number of activities included in the KSA textbook for the fourth grade did not improve students' acquisition of basic SPS.

Studies on the representation of SPS in textbooks in UAE context

In the UAE context, few studies were found to be concerned with the analysis of the level of incorporation of basic and integrated SPS in Emirati science textbooks Al-Naqbi (2015) aimed to identify the basic abilities of scientific inquiry including SPS in the first four grades of Emirati science workbooks using content analysis. He found that the activities did not allow students to write conclusions, plan investigations, or formulate questions; instead, they developed the students' skills with measurement, observation, and presentation of results. Additionally, the science workbook activities taught students to handle tools such as magnifying glasses, watches, scaled tubes, beam balances, and rulers but gave the students few opportunities to use mathematical operations, computers, or even calculators. Al-Naqbi (2015) recommended that Emirati primary science workbooks ensure students practice their inquiring, communicating, planning, concluding, and implementing skills and provide access to technical tools such as calculators, microscopes, and laptops.

In summary, although many researchers have examined the representation of SPS in science textbooks, most of these studies were conducted outside the UAE (for instance, in Turkey, Palestine, and KSA). There seems to be a gap in research dealing with the representation of SPS in UAE science textbooks. This study was motivated by the limited research on how SPS is represented in science textbooks.

Context of the study

The schools in the UAE implement a variety of curricula, including from the United States, the UK, and the Emirati MOE. Furthermore, the MOE public and private schools implement different curricula. For example, public schools follow the Inspire Science curriculum, whereas private schools follow the integrated science curriculum. This study focused on analyzing the integrated science MOE curriculum used in private schools for fifth-grade students.

Research design

The current quantitative study applied a content analysis approach, one of the widely used descriptive–analysis methods for analyzing the content of textbooks (Sideri & Skoumios, 2021). Content analysis entails encoding and interpreting text to form replicable and valid conclusions (Maurya & Rani, 2019). Content analysis can be used to assist in the practical and scientific examination of justifications, concepts, attitudes, and needs within a textbook's content (Sideri & Skoumios, 2021). Moreover, content analysis helps the researcher identify the most common themes for further explanation (Qadeer, 2013) and, in this case, was suitable to answer the two research questions related to the representation of basic and integrated SPS in the activities of fifth-grade Emirati science textbooks.

Data sources

The data for the current study drawn from the content analysis for this study incorporated the three MOE-approved integrated science textbooks for fifth-grade students, specifically the 2021 - 2022 edition. All three textbooks were available in English and Arabic. A total of 40 inquiry activities were identified in the three textbooks, one for each of the three semesters. The first-semester textbook contained 4 units, 14 lessons, and 17 activities (Table 1); the second-semester textbook contained 3 units, 8 lessons, and 10 activities (Table 2) and the third-semester book included 3 units, 8 lessons, and 13 activities (Table 3). The tables indicate that not all lessons in the analyzed science textbooks contain inquiry activities. Table 1 shows that there are two lessons in the first textbook, the third and fourth lessons of the third unit, which did not contain inquiry activities.

Table 1: The content of the first-semester science textbook

Unit No.	Unit Title	Lesson Title	No. of Inquiry Activities
1	Building a Better Scientist	1.1 Becoming a Scientist	1
		1.2 The Scientific Method	2
		1.3 Tools of the Scientist	2
		1.4 Making Measurements	2
2	Parents and Offspring	2.1 Reproduction	1
		2.2 Plant Life Cycles	2
		2.3 Animal Life Cycles	1

3	Interactions in Ecosystems	3.1 Photosynthesis	2
		3.2 Energy Flow in Ecosystems	1
		3.3 Relationships in Ecosystems	0
		3.4 Adaptation and Survival	0
4	Using Earth's Resources	4.1 Natural Resources	1
		4.2 Uses of Resources	1
		4.3 Cycles in Ecosystems	1

Table 2: The content of the second-semester science textbook

Unit No.	Unit Title	Lesson Title	No. of Inquiry Activities
5	Comparing Kinds of Matter	5.1 Elements	1
		5.2 Metals, Nonmetals, and Metalloids	2
6	Physical and Chemical Changes	6.1 Mixtures	1
		6.2 Compounds and Chemical Changes	1
		6.3 Acids, Bases, and Salts	1
7	Using Forces	7.1 Motion	1
		7.2 Forces and Motion	1
		7.3 Work and Energy	2

Table 3: The content of the third-semester science textbook

Unit No.	Unit Title	No. of Lessons	Lesson Title	No. of Inquiry Activities
8	Using Energy	2	8.1 Sound	2
			8.2 Light	1
9	Minerals, Rocks, and Soil	3	9.1 Minerals	2
			9.2 Rocks	2
			9.3 Soil	2
10	Technology and Design	3	10.1 Technology and Your Life	1
			10.2 Technology and Nature	1
			10.3 The Design Process	2

Analysis framework

Appendix A presents the analysis framework for examining the science textbooks for their representation of basic and integrated SPS in the inquiry activities. This framework was created referring to two frameworks by Jahjouh (2008) and Yang and Liu (2016). The framework included a list of all basic and integrated science process skills and their indicators to monitor the frequencies and percentages of occurrences of SPS in each inquiry activity. This framework focused on analyzing eight basic SPS, observing, measuring, classifying, inferring, predicting, using numbers, using space-time relationships, and communicating, and six integrated SPS, defining operationally, hypothesizing, interpreting data, formulating models, controlling variables, and experimenting.

Data collection and procedures

The following procedures were followed to collect the data for the current study. First, the Arabic versions of all three textbooks were collected for the three semesters of the academic year 2021 - 2022. Second, the total number of inquiry activities included in the three Emirati 5th-grade science textbooks was calculated (Tables 1 - 3). Third, the inquiry activities were examined to determine the extent to which they represented basic and integrated SPS. Fourth, during the analysis process, each step in each inquiry activity was examined to determine whether this step included SPS content, specifically the 14 skills listed in the analysis framework. Finally, the frequencies and percentages of each skill were calculated for each textbook's inquiry activities.

Data analysis

The 14 process skills that were present in the 40 inquiry activities were analyzed to determine the level of representation of SPS in the Emirati science textbooks for the fifth grade. Three Emirati fifth-grade science textbooks were analyzed one for each of the three semesters; each consisted of 10 units and 40 inquiry activities. The analysis focused on the activities in each lesson of the science textbooks. Each activity step was chosen as an analysis unit. Each analysis unit was examined in terms of their frequencies and the percentage of each of the 14 SPS. After the activities were analyzed, Microsoft Excel was used to graphically plot the frequencies and percentages of basic and integrated SPS represented in the inquiry activities of the fifth-grade Emirati science textbooks.

Reliability

The reliability of the content analysis we establish via the interrater approach. Both the researcher and an experienced science teacher used the framework and analyzed the same dataset independently for the representation of basic and integrated SPS. Then, the study researcher calculated the coefficient of

agreement between the two results by comparing them according to Cohen's Kappa of agreement coefficient (K) (Stemler, 2001).

Cohen's Kappa of 1 denotes perfect reliability, and 0 denotes no agreement beyond that which can be expected by chance (Stemler, 2001). In this study, the agreement coefficient between the two analysts was 0.87; according to Stemler (2001), this coefficient is acceptable as the agreement is almost perfect if it is between 0.81 and 1.00.

Results

Research question 1

The first research question of this study was: To what extent are basic SPS represented in the inquiry activities of fifth-grade Emirati science textbooks?

To answer this question, the percentage of the number of activities represented by each of the basic skills was calculated, as shown in Table 4. Table 4 displayed that the percentages of the number of activities represented by the basic SPS were in the following order: communicating, inferring, observing, measuring, using numbers, classifying, predicting, and using space-time relationships in percentages of 100%, 92.5%, 85%, 57.5%, 52.5%, 50%, 27.5%, and 2.5%, respectively.

Table 4: Percentages of activities that referred to each basic science process skill

Basic SPS	Percentage of Activities (%)
Observing	85
Measuring	57.5
Classifying	50
Inferring	92.5
Predicting	27.5
Using Numbers	52.5
Using Space-time Relationships	2.5
Communicating	100

The results of the frequency of occurrences and percentage of basic SPS in inquiry activities are displayed in Table 5. According to Table 5, all the basic SPS were represented in the activities with a frequency of occurrences equivalent to 593 times and a percentage equal to 86.94%. Furthermore, the eight basic SPS were not represented in a balanced manner in all activities; For example, measuring was the most represented skill across all the inquiry activities in the three science textbooks, referred to 138 times (20.23%); use of numbers followed at a frequency of 137 times (20.09%). While the skill of using space-time relationships was the least represented.

Table 5: Frequencies and percentages of representations of the eight basic science process skills across all inquiry activities

Basic SPS	Frequency of Occurrences	Percentage (%)
Observing	128	18.77
Measuring	138	20.23
Classifying	50	7.33
Inferring	68	9.97
Predicting	14	2.05
Using Numbers	137	20.09
Using Space-time Relationships	3	0.44
Communicating	55	8.06
Total	593	86.94

Research question 2

The second research question of this study was: To what extent are integrated SPS represented in the inquiry activities of the fifth-grade Emirati science textbooks?

To answer this research question, the inquiry activities of the three textbooks were analyzed to examine the extent to which the six integrated SPS are represented. Table 6 shows that the percentages of the number of activities represented by the integrated SPS were varied and came in the following order: experimenting, interpreting data, hypothesizing, formulating models, controlling variables, and defining operationally in percentages of 82.5%, 42.5%, 32.5%, 30%, 25%, and 0%, respectively.

Table 6: Percentages of activities that referred to each integrated science process skill

Integrated SPS	Percentage of Activities (%)
Defining Operationally	0
Hypothesizing	32.5
Interpreting Data	42.5
Formulating Models	30
Controlling Variables	25
Experimenting	82.5

Next, the frequencies and percentages of the occurrences of the six integrated SPS were measured, as shown in Table 7. Across all three textbooks' activities, integrated SPS were represented only 89 times in 13.06% of activities, both very low compared with the basic SPS representation. As with the basic skills, the representation of the integrated skills was imbalanced across activities. For example, experimenting was the most frequent integrated SPS (33 times, 4.84%), followed by interpreting data (19 times, 2.79%). Whereas defining operationally was the least represented in the inquiry activities of the analyzed textbooks.

Table 7: Frequencies and percentages of representation of the six integrated science process skills across all inquiry activities

Integrated SPS	Frequency of Occurrence	Percentage (%)
Defining Operationally	0	0
Hypothesizing	13	1.91
Interpreting Data	19	2.79
Formulating Models	13	1.91
Controlling Variables	11	1.61
Experimenting	33	4.84
Total	89	13.06

According to Table 7, across all three textbooks, the integrated SPS were represented 89 times in 13.06% of the activities, which is very low compared to the representation of basic SPS, as shown previously in Table 5. Moreover, it was noted from Table 7 that the six integrated SPS were not represented in a balanced manner because some integrated skills were more represented than others.

Discussion and conclusion

This study aimed to examine the extent to which basic and integrated SPS are represented in the inquiry activities of three fifth-grade science textbooks used in private schools in the UAE for three semesters of the 2021–2022 academic year using content analysis.

According to the results, all eight basic SPS were represented in the analyzed activities but not all six integrated skills were represented; no activities incorporated defining operationally. The skills were represented with different frequencies and percentages according to the topics of the activities of the analyzed units. The representation of the basic and integrated SPS was thus imbalanced, mainly because of the difference in the units covered in the three textbooks (e.g. life sciences, physical sciences, earth and space sciences, and technology and engineering sciences). Therefore, it is necessary to represent all basic and integrated skills among the inquiry activities because there are a variety of advantages of basic and integrated SPS; these skills help students study science, encourage active participation, foster a sense of responsibility among students for their education, make learning more lasting and enable students to build research techniques (Yalçinkaya-Önder et al., 2022). The imbalance in the representation of basic and integrated SPS is consistent with findings from previous researchers (Aljarallah, 2020; Dökme, 2005; Jahjouh, 2008; Ozkan & Umdu Topsakal, 2021; Yalçinkaya-Önder et al., 2022).

Moreover, the results indicate that basic SPS are more represented than integrated SPS; this is because basic SPS were more common in the activities than integrated SPS. For example, in many cases the integrated SPS require students to first develop the basic SPS, therefore some activities may focus on the basic SPS in order to prepare students for later activities that involve integrated SPS.

The better representation of basic SPS as compared to integrated SPS in the analyzed activities is more consistent with previous studies (Jahjouh, 2008; Yumuşak, 2016). In addition, this result simultaneously agrees with and contradicts the findings of Ozkan and Umdu Topsakal (2021), who conducted their study for grades four to eight. They found that basic skills were more represented than integrated skills in the fourth-grade science textbook but that integrated skills were more frequent in the textbooks for the fifth, sixth, seventh, and eighth grades.

According to the results, measuring, using numbers, and observing were the most frequent skills of basic SPS in the analyzed activities, with percentages of 20.23%, 20.09%, and 18.77%, respectively. The percentages for measuring and using numbers were very similar because measuring entails being able to use numbers to measure different units or measurements. Meanwhile, observing was frequently used because it forms the foundation of the pyramid of learning other SPS. Simply basic SPS are at the core of cycle one curriculum based on the cognitive level of the learner (link to Piaget theory). Observation and measurement, for example, represent the first step in knowledge construction (Al-Shaeeli & Khataibeh, 2003).

These results were consistent with Aljarallah's (2020) finding that observation and measurement were among the most frequent skills in the activities in the fourth-grade science textbook for KSA. Furthermore, this is consistent with the results of previous studies (Dökme, 2005; Jahjouh, 2008; Yalçinkaya-Önder et al., 2022) that found that observing was the most represented skill in science textbooks. However, these results contradict those of Ozkan and Umdu Topsakal (2021), who found that measurement was the least frequently represented in their research.

In the study findings, inferring was the fourth most represented skill in the science learning activities, followed by communicating and classifying. These percentages are close and high compared to the skills that follow them.

Inferring was represented in 92.5% of analyzed activities. Communicating, however, was represented in all analyzed activities, at different frequencies and percentages. Meanwhile, classifying was represented in 50% of the analyzed activities, and therefore, its representation should be increased in the fifth-grade science textbooks in the UAE.

The results showed that predicting was one of the least represented basic SPS in all activities of the analyzed science textbooks, with a percentage of 2.05% overall; most units did not include prediction at all, and in the tenth unit, where it did appear, predicting was represented in only 27.5% of the activities that were analyzed. Given these findings, along with classification, prediction is a skill that UAE fifth-grade science textbooks need to incorporate into their learning activities. This result is consistent with the results of some previous studies (Aljarallah, 2020; Dökme, 2005; Jahjouh, 2008).

Overall, the skill of using space-time relationships was the least represented basic SPS in the analyzed activities at 0.44%; this skill was only represented in the first lesson in the seventh unit, which asked students to calculate the average speed of a glass ball at three different distances. This indicates that using space-time relationships should be incorporated into the curricula, especially in the activities of the units related to the field of physical sciences (Jahjouh, 2008).

The results showed that experimenting was the most represented integrated SPS among the activities analyzed in the current study at 4.84%; it was represented in 82.5% of the activities. Interpreting data came in at 2.79% with representation in 42.5% of the analyzed activities in the three Emirati fifth-grade science textbooks. Hypothesizing and formulating models were third in representation in the inquiry lessons at 1.91% each, hypothesising was represented in 32.5% of the analyzed activities while formulating was represented in 30% of the activities.

The low representation of the skills of hypothesizing and formulating models indicates that the activities of the analyzed units should focus on representing these two skills. Controlling variables skill was nearly the least represented integrated SPS in the analyzed activities at 1.61%, being represented in only 25% of analyzed activities. Finally, defining operationally was the least represented integrated SPS in all the analyzed activities of the units, indicating that representation of this skill in particular needs to increase within the curriculum and textbooks for fifth-grade science in the UAE.

Recommendations

The findings of this study suggest several recommendations:

- The designers of future Emirati integrated science textbooks for the fifth grade need to add at least one inquiry activity in the third and fourth lessons in the life sciences unit to develop and enhance the ability of fifth-grade students to develop SPS that are conducive to making scientific inquiries in life sciences.
- A better-balanced representation of the eight basic and six integrated SPS across the inquiry activities of the three textbooks is highly recommended to allow students to develop balanced inquiry-related skills, and hence better understanding of science.
- The developers of the integrated science Curricula at the McGraw-Hill Education Foundation in the UAE must review the inquiry activities of the three science textbooks for the fifth grade and enhance those activities with more integrated SPS in line with the developmental needs of Grade 5 students, because, as the results of this study show, the frequency of basic SPS is much more compared to that of integrated SPS in these activities.

- Developers and designers of the integrated science curricula at the McGraw-Hill Education Foundation in the UAE must focus on providing the skill of using space-time relationships in the inquiry activities of the Emirati science textbooks for the fifth grade, especially for activities related to the field of physical sciences.
- Developers and designers of the integrated science curricula at the McGraw-Hill Education Foundation in the UAE should increase the representation of some of the SPS, such as predicting, hypothesizing, interpreting data, formulating models, and controlling variables.
- Teachers in the UAE schools should be trained in providing balanced learning of SPS both basic and integrated to compensate for any imbalanced representation made by textbooks.
- Teachers in the UAE schools should also be assisted to stress in their teaching the significance of the SPS as tools and mental processes that represent the first line in knowledge construction.

Implications for future research

The following suggestions for future research can be made in light of the results of this study. First, to complement the current study, future research should analyze the contents of the Emirati integrated science textbooks for the fifth grade, including texts and questions to investigate the representation of basic and integrated SPS in the activities. Second, future studies should examine the extent to which basic and integrated SPS are represented in the contents of the Emirati integrated science textbooks for the second cycle.

Third, researchers are suggested to examine how science teachers of the second cycle who work in UAE schools employ different SPS. Future research should aim to identify the level of fifth-grade students' acquisition of basic and integrated SPS in Emirati integrated science textbooks.

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تمثيل مهارات عمليات العلم في كتب العلوم للصف الخامس في دولة الإمارات العربية المتحدة

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ملخص البحث:

إن تمثيل مهارات عمليات العلم في أنشطة كتب العلوم أمر ضروري، وله دور كبير في دفع الطلاب نحو المعرفة العلمية المتوازنة. للتأكد من أن كتب العلوم المدرسية تقدم ما كان من المفترض أن تقدمه، يجب مراجعة محتواها العلمي وتحليله وتقييمه بانتظام. ومع ذلك، واستنادا إلى الأدبيات، هناك عدد قليل من الدراسات العلمية التي تناولت أنشطة كتب العلوم المتكاملة المعتمدة والمستخدمة من قبل وزارة التربية والتعليم في دولة الإمارات العربية المتحدة في ضوء التمثيل المتوازن لمهارات عمليات العلم الأساسية والمتكاملة. ولذلك تبحث هذه الدراسة في مستوى تمثيل مهارات عمليات العلم الأساسية والمتكاملة في الأنشطة الاستقصائية لكتب العلوم المتكاملة الإماراتية لدى طلاب الصف الخامس الأساسي باستخدام تحليل المحتوى كمنهج وصفي تحليلي. تحليل المحتوى هو نهج متعدد الأبعاد لفهم المعاني أو الأبعاد المختلفة لنص معين. أشارت النتائج إلى أن بعض مهارات عمليات العلم الأساسية والمتكاملة في الأنشطة التي تم تحليلها كانت ممثلة بشكل أفضل من غيرها، مثل القياس واستخدام الأرقام والملاحظة والتجريب. أخيرًا، تناقش الدراسة هذه النتائج في سياق دولة الإمارات العربية المتحدة، وتعرض آثارها على التعليم والتعلم وكذلك على مصممي المناهج ومطوريها

الكلمات الدالة: تحليل المحتوى، مهارات عمليات العلم، كتب العلوم الإماراتية، الصف الخامس

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