Jordan Journal of Educational Sciences Vol 13, No. 2, pp 251 -262

An Analysis of Jordan's Adherence to the NCTM Standards for First Grade Reformed Mathematics Textbooks

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Received Date: 12/7/2016 **Accepted Date: 29/9/2016**

Abstract: This study investigated the compliance of Jordan's reformed mathematics textbooks for first-graders to the National Council of Teachers of Mathematics' (NCTM, 2000) standards. The population and the sample of the study consisted of the reformed mathematics textbooks for first-graders in Jordan. An analysis instrument was designed. The validity and reliability of the instrument were ensured. The reformed 2015 mathematics textbook was analyzed with this instrument. The results of the study revealed that the reformed mathematics textbook complied with (31) indicators of (NCTM) standards resulting in a compliance rate of 68%. However, the content did not achieve (14) indicators in the five areas of the content standards. Also, the reformed mathematics textbooks neglected the data analysis and probability standard. The study recommends the following in light of the results: conduct further studies on each grade from kindergarten through twelfth grade, analyzing both the content and process standards of the curriculum

(**Keywords**: Mathematics Textbooks, First Grade, NCTM s, Content Analysis, and Jordan).

تحليل كتاب الرياضيات المطور للصف الأول في الاردن في ضوء معايير NCTM

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ملخص: هدفت هذه الدراسة إلى استقصاء مدى تضمين محتوى كتاب الرياضيات المطور للصف الأول الأساسي لمعايير المجلس القومي الأمريكي لمعلمي الرياضيات (NCTM). وقد تم بناء أداة للتحليل في ضوء المعايير العالمية (NCTM, 2000)، ثم التأكد من صدقها وثباتها. تكون مجتمع الدراسة وعينتها من كتاب الرياضيات المطور للصف الأول الأساسي في الأردن. وبعد القيام بعملية التحليل لكتاب الرياضيات المطور 2015\2016، أظهرت نتائج الدراسة أن محتوى كتاب الرياضيات المطور للصف الأول يتضمن (31) مؤشرا من معايير المجلس القومي الأمريكي لمعلمي الرياضيات (NCTM) بنسبة (68%)، بينما لم يتضمن (14) مؤشرا بما نسبته (32%) في المجالات الخمسة من تلك المعايير. كما أظهرت أن كتب الرياضيات أغفلت محور الاحتمالات والإحصاء واهتمت بتضمين كل من محاور الأعداد، والهندسة، والقياس، والجبر بنسب متفاوتة. وقد أوصت الدراسة بإجراء المزيد من الدراسات لبحث مدى مراعاة كتب الرياضيات للصفوف من الروضة وحتى الثاني ثانوي لكل من معايير المحتوي والعمليات لمعايير المجلس القومي الأمريكي لمعلمي الرياضيات (NCTM).

(**الكلمات المفتاحية:** كتب الرياضيات، الصف الأول، معايير المجلس القومي الأمريكي لمعلمي الرياضيات (NCTM، تحليل المحتوى، الأردن.)

Introduction

Textbooks are viewed as a vital and major source of information; and in some cases, are the only method of exposure to the student for any subject matter (Al-Zubi & Al-Obeidan, 2014; Keith, 1991). Textbooks on mathematics are utilized as the major organizer of mathematical skills that students are expected to master (Chiappetta & Fillman, 2007), and are the primary resource for teachers (Al-Zubi & Al-Obeidan, 2014; Jitendra, Griffin, & Yan Ping, 2010; Mrayyan, 2013). Additionally, Schmidt, Houang, and Cogan (2002) stated that Mathematics textbooks' content and instructional practice influence student learning. Clearly, textbooks, particularly in mathematics, are vital to teaching and learning.

Abed and Al-Absi (2015) stated the aims of teaching mathematics in Jordan should be the following; Teachers should enable students to acquire knowledge, skills, values and attitudes to help them in their individual and collective development. Teachers should represent the reality of the subject by putting the student through life-like situations where they use the learned skill. Also, teachers should help students to be able to solve the problems and issues related to the needs of everyday life.

The process of evaluating curriculum and textbooks, including mathematics textbooks, has become necessary to objectively text their effectiveness in teaching students. This is especially the case when institutions are implementing something new or different and they want to further develop the curricula and textbooks through observation and follow-up (Abu Zinh, 2010). Many experts see the need to review mathematics textbooks every five to seven years (Al Ser, 2007). According to Abu Zinh (2010), as well as Alyat and Duwairy (2015), the process of analyzing and evaluating textbooks is considered both a diagnostic and therapeutic process at the same time, leading to the development of curriculum and improving the quality of textbooks.

Many previous researchers have investigated mathematics programs based on NCTM standards (Ardisana, 2006; Blackwell, 2001; Heitmann, 2006; Jitendra et al., 2010; Wood, 2006). These past researchers have found a positive relationship between learning outcomes and achievement of students in mathematics based on the design of the textbooks' compliance to NCTM standards. These standards have

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been shown to improve learning outcomes and achievement of students in mathematics, raise the level of student achievement in mathematical knowledge and skills, address the lower level students learning mathematics, and improve the professional growth of teachers and educational leaders.

For example, Jitendra et al. (2010) conducted a case study exploring the influence of the intended textbook and the implemented curricula's (teachers' instructional practice) adherence to the NCTM standards on student outcomes in mathematics from four classrooms in one elementary school. Textbook and teacher adherence to the standards were evaluated using content analysis and direct observation procedures, respectively. They found that a relationship between more NCTM standards being used to improved student achievement and attitude toward mathematics.

Jordan has undergone a continuous reform process in the previous years on curricula in general, and mathematics curricula particularly (Alyat & Duwairy, 2015). All public and private schools in Jordan apply the mathematics curricula issued by the Ministry of Education (MOE), and some private schools use additional curricula in mathematics to support the specific educational level and needs of students. Past studies of Jordanian mathematic textbooks concluded there was a need for further development of textbooks in order to meet NCTM requirements and other international standards (Abed & Al-Absi, 2015; Alyat & Duwairy, 2015; Duwairy, 2005; Mrayyan, 2013).

NCTM and Principles and Standards for School Mathematics

The National Council of Teachers of Mathematics (NCTM) is an international organization that supports teaching and learning of mathematics for children from Pre-Kindergarten through Grade 12. It was founded in 1920 as an outgrowth of the Chicago Mathematics Club. Over the years, NCTM has produced various documents intended to guide K–12 mathematics education .

In (1989), the NCTM produced the first contemporary set of subject matter standards in the United States. This was updated and expanded in (2000), when the NCTM published Principles and Standards for School Mathematics, a document that has become the basis for state and local mathematics curriculum standards across the United States. Furthermore, this document contains a set of six principles that serve as a basis for the recommendations in the document, and ten standards that generally describe the mathematics skills that students should by each year through grade 12 (NCTM, 2000).

Mundy (2000) stated that the NCTM's mission is "to provide the vision and leadership necessary to ensure a mathematics education of the highest quality for all students" (p. 868). The NCTM Standards are widely utilized in the K-12 community because of its importance to teaching and learning mathematics (Ardisana, 2006; Blackwell, 2001; Heitmann, 2006; Wood, 2006).

The NCTM has two categories of standards (NCTM, 2000): content standards, which describe the mathematical content that students should learn at each grade level; and process standards, which focus on the different methods that students use to acquire, understand, and use the content. These different methods, as determined by the NCTM, are: (1) problem solving, (2) reasoning and proof, (3) communication, (4) connections, and (5) representation. The five content standards are: (1) number and operations, (2) Algebra, (3) Geometry, (4) measurement, and (5) data analysis and probability.

This study delimited the research to the five NCTM content standards, and the content analysis of Jordanian mathematics textbooks was limited to the first grade basic educational level. A description for the five areas of content standards (NCTM, 2000) follows, as these were used in the study. Each standard has sub-categories, made up of what the NCTM consider to be the expected skills for children at this age:

- Number and operations standard: Children should be able to: (1) understand numbers, ways of representing numbers, relationships among numbers, and number systems; (2) understand meanings of operations and how they relate to one another; and (3) compute fluently and make reasonable estimates.
- Algebra standard: Children should be able to: (1) understand patterns, relations, and functions; (2) represent and analyze mathematical situations and structures using algebraic symbols; and (3) use mathematical models to represent and understand quantitative relationships.
- Geometry standard: Children should be able to: (1) analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships; (2) specify locations and describe spatial relationships using coordinate geometry and other representational systems; (3) apply transformations and use symmetry to analyze mathematical situations; and (4) use visualization, spatial reasoning, and geometric modeling to solve problems.
- Measurement standard: Children should be able to: (1) understand measurable attributes of objects and the units, systems, and processes of measurement; and (2) apply appropriate techniques, tools, and formulas to determine measurements.

•Data analysis and probability standard: Children should be able to: (1) formulate questions that can be addressed with data; and (2) collect, organize, and display relevant data to answer them; (3) and understand and apply basic concepts of probability.

Six years later, the NCTM presented Focal Curriculum Points for Prekindergarten through Grade 8 Mathematics: A Quest for Coherence (NCTM, 2006), which built on Principles and Standards for School Mathematics (NCTM, 2000). This new publication was offered as a starting point in a dialogue on what is important at particular levels of instruction and as an initial step toward a more coherent, focused curriculum. Focal Curriculum Points was a response to the challenges teachers often face with long lists of mathematics topics or learning expectations to address at each grade level, but "lacking clear, consistent priorities and focus, teachers stretch to find the time to present important mathematical topics effectively and in depth" (NCTM, 2006, p. vii). Furthermore, NCTM (2006) offered opportunities for improving the teaching and learning of mathematics and provided descriptions of the most significant mathematical concepts and skills at each grade level. It provided a clear emphasis on the processes that NCTM (2000) addressed, and focused on how to organize curriculum standards within a coherent, focused curriculum. It did this by showing how to build on important mathematical content for each grade level from pre-K–8 (NCTM, 2006).

The evaluation of mathematics textbooks' content according to NCTM standards has been addressed by many researchers (Abed & Al-Absi, 2015; Abu Alrub, 2007; Alshehri & Ali, 2016; Alyat & Duwairy, 2015; Al-Zubi & Al-Obeidan, 2014; Duwairy, 2005; Hasanen & Al-Shahrei, 2013; Kulum, 2000; Mrayyan, 2013). For example, Hasanen and Al-Shahrei (2013) investigated the compliance of developed mathematics textbooks' content (grades 3-5) in Saudi Arabia with NCTM standards; specifically, in the area of number and operations, algebra, geometry, measurement, data analysis and probability. The results revealed that the reformed mathematics textbooks' content for grades (3-5) in Saudi Arabia was compatible with (59) indicators of (NCTM) standards, resulting in a 93.7% compliance rate; while the content did not achieve (4) indicators (6.3%) in the five areas.

Furthermore, Nassar (2011) showed that Palestinian mathematics curriculum content in grades (6-8) lacked (18) algebra concepts in terms of NCTM standards. The study Shatat, Obeid, and Abdulfatah (2009) tested whether the construction of mathematics curriculum standards in grades (1-6) were consistent with Egyptian national standards indicators. Al Assaf's (2008) study results showed that the compliance with NCTM standards in the areas of geometry and measurement in grades (3-5) in Saudi Arabia varied. The study found content lacked in 43.24% of the sub-categories in Geometry, and 25% of the content in measurement standards. The study Hilal (2009) revealed that Algebra content Saudi Arabian middle schools consider only three NCTM standards. Also, in a comparative study, Duwairy and Alqudah (2006) investigated mathematics curricula content in Saudi Arabia and Jordan with regard to NCTM standards. They found a difference between mathematics curricula content in Saudi Arabia and Jordan in terms of compatibility with NCTM standards in favor of Saudi curricula content in the area of representation and connections.

In (2014), Al-Zubi and Al-Obeidan examined the extent of fourth-grade mathematics textbooks in Saudi Arabia meeting the NCTM standards. An analysis instrument was designed; the validity and reliability of the instrument were ensured. The content analysis results of the study showed that the fourth-grade mathematics textbook included the following: numbers and common operations (2.03% - 14.57%), geometry (6.42 % - 13.58%), probability and analysis features (6.98% - 15.12%), problem solving (9.41 % -28.24%), thinking and reasoning (5.17% - 15.52%), communication (4.30% -25.81%). The study recommended the following in light of the results: conducting more studies concerning the NCTM standards, as well as involving other variables such as other textbooks of the preparatory and secondary stages.

In a recent study, Alshehri and Ali (2016) also investigated the compliance of developed mathematics textbooks' content (grades 6-8) in Saudi Arabia with NCTM standards. They found that the content of developed mathematics textbooks for grades (6-8) represented 52 indicators from the NCTM content standards and was compliant with 96.3% of indicators, while 3.7% from the NCTM standards indicators list were not achieved.

In Jordan, Mrayyan (2013) analyzed the geometry content of mathematics textbooks for grades one through six in Jordan according to the NCTM standards. A content analysis instrument with four categories ranging from not available to highly available was developed. According to the study's results, more attention and professionalism should be applied when preparing math curricula and textbooks taking into consideration NCTM standards. In a different study, Abu Rub (2007) aimed to analyze geometry and measurement in basic stage mathematics textbooks in Jordan compared to NCTM standards. The results showed that the percentage of the availability of geometry standards was (25%, 7%, 0.00 %, & 28%). The results also showed that the percentage of the availability of measurement criteria was (6%, 23%).

Sbeah (2004) also conducted an analysis and evaluation of mathematics textbooks in Jordan

according to a model developed from NCTM standards. Geometry and measurement were analyzed for content. She found that mathematics textbooks for ninth and tenth grades have zero chapters covering the topic of measurement. Further, Alyat and Duwairy (2015) analyzed Geometry content of mathematics textbooks for the intermediate basic stage in Jordan compared to NCTM standards. To achieve the purpose of their study, the researchers developed a model for analysis derived from NCTM (2000). They found a varying amount of representation from one standard to another in mathematics textbooks from sixth to eighth grade. The percentages of the Geometry standard in respect to representing the NCTM indicators ranged between (0% - 69.71%) for the sixth-grade level; between (4.52% - 56.11%) for the seventh-grade level; and between (1.96% - 54.81%) for the eighth-grade level .

Abed and Al-Absi (2015) investigated Jordanian Elementary textbooks between the years 1970 to 2013, in order to determine the types of mathematical disciplines found in these textbooks. The study evaluated mathematics textbooks and identified types and quantities of mathematics. They examined the relative quantity of mathematics, areas of mathematics, and methods. Books were analyzed using content analysis protocols. The results showed a significant increase in mathematics enhancement in terms of quality and quantity in Jordanian elementary textbooks. Such enhancement was related to the advantage of new technology based on mathematical algorithms. In addition, this research pointed out the growth in geometry, while numbers of mathematics, in return, showed a decline up to the end of the study year of 2013. This study also concluded by recommending developing textbooks to further meet NCTM requirements.

In conclusion, while the evaluation of mathematic textbook content according to NCTM standards in Jordan has been addressed by a number of researchers in the past (Abed and Al-Absi, 2015; Abu Alrub, 2007; Alyat & Duwairy, 2015; Duwairy, 2005; Mrayyan, 2013; Sbeah, 2004), only one study could be found that investigated Jordanian mathematics textbooks for the first three grades (Abed & Al-Absi, 2015). However, their study was closer to a meta-analysis examining mathematics textbooks from 1970–2013, while the current study investigated first-grade mathematics textbooks that were reformed in 2015. Therefore, the purpose of this study was to evaluate the extent that the newly reformed mathematics textbooks reflect NCTM standards .

Research Problem and Questions

Many ways exist to organize curricula. The challenge is to avoid those that distort mathematics and turn off students (Steen, 2007). Another challenge is to organize curricula that reflect a deeper understanding of mathematics content to ensure that all students have access to important math content (National Mathematics Advisory Panel, 2008). According to Queen Rania's Award (QRA) (2010), while many improvements have occurred in Jordanian textbooks, some problems still exist, particularly those that are related to teachers still following traditional strategies in teaching that have been shown to be ineffective. Abed and Al-Absi (2015) stated that NCTM standards were advocated for teaching mathematics at the end of 1989. Since that time, still not all teachers are on board.

While the reformed mathematic textbooks in Jordan were developed to match NCTM content standards for the first three grades, textbooks and school curricula still in use do not always place enough emphasis on the development of NCTM content standards (Abed & Al-Absi, 2015; Mrayyan, 2013). Therefore, it is crucial to examine the extent the reformed mathematics textbooks reflect NCTM standards while the latest curricula reform in Jordan is still new, starting in the 2015/2016 academic school year (MOE, 2016). The problem of this study reflects the need to identify the compliance of the reformed mathematics textbook's content (first grade) in Jordan with NCTM standards. Thus, the purpose of this study was to investigate the compliance of first-grade Jordanian reformed mathematics textbook content with NCTM standards, specifically relating to the 5 content standards described above. Based on the study's problem and purpose, the attempted to address the following central question and five sub-questions :

To what extent does the content of Jordanian first-grade mathematics textbooks match NCTM standards?

The following research sub-questions guided this study :

1 To what extent is the representation of the NCTM standards incorporated in the content of the Jordanian first-grade mathematics textbooks in terms of Numbers and Operations?

2 To what extent is the representation of the NCTM standards incorporated in the content of the Jordanian first-grade mathematics textbooks in terms of Algebra?

3 To what extent is the representation of the NCTM standards incorporated in the content of the Jordanian first-grade mathematics textbooks in terms of Geometry?

4 To what extent is the representation of the NCTM standards incorporated in the content of the Jordanian first-grade mathematics textbooks in terms of Measurement?

5 To what extent is the representation of the NCTM standards incorporated in the content of the Jordanian first-grade mathematics textbooks in terms of data analysis and probability?

Significance of the Study

Based on the discussion above, it is clear that the evaluation of mathematics textbooks in light of the NCTM standards represents an important pillar in the development of teaching and learning mathematics, especially at the primary level. Furthermore, analysis processes have been useful in understanding the content of textbooks, explain what is meant, and explore strong and weak points of the text, all of which increases the textbook's effective use in the teaching process. Moreover, this study highlights the importance of investigating mathematics content in textbooks and the importance of modern textbooks to reflect the better understanding gained from the reforms made to the educational system. Finally, it is hoped that this research will pave the way for more research in this particular field.

Limitations of the Study

This study was limited to the five NCTM content standards that was published in 2000 (NCTM, 2000), Jordanian mathematic textbooks that were published by ministry of education and the analysis conducted the students' textbooks of the first grade of the basic educational level that reformed in 2015.

Procedural Definitions

- Content standard: Refers to the NCTM's descriptions of the five strands of content that students should learn: number and operations, algebra, geometry, measurement, and data analysis and probability.
- NCTM standards: taken from a document published by the National Council of Teachers of Mathematics (NCTM, 2000) in the United States of America. Refers to mathematical understanding, knowledge, and skills that students should acquire.

Method

Study Method:

This study utilized content analysis protocols to investigate the compliance of reformed mathematics textbook for Jordanian first-grade students in relation to the NCTM standards in the areas of number and operations, algebra, geometry, measurement, data analysis and probability. According to Berelson (1952), content analysis is "a research technique for the objective, systematic, and quantitative description of manifest content of communications" (p. 74). Also, Krippendorf (2004) stated, "Content analysis is a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (p. 18). This technique was used to find the percentage of mathematics content in the textbooks that was compliant with NCTM standards, in terms of page and lesson.

Sample

The population and the sample of the study would be considered the content of the Jordanian first-grade mathematics textbooks developed in 2015\2016. The content of these textbooks consisted of two different parts: the first part has 26 lessons and 70 pages, and the second part has 22 lessons and 75 pages. Thus, 48 lessons were analyzed according to NCTM standards.

Instruments

All 48 lessons were examined related to the five content areas previously described. To achieve the purpose of this study, a list of NCTM standards of mathematics textbooks content for first-graders was prepared (NCTM, 2000). Also, a content analysis checklist card of the reformed mathematics textbook for first grade in the academic year 2015-2016 in light of the list of NCTM standards was prepared. Table 1 presents the number of NCTM Standards and expectation for the first grade mathematics textbook (NCTM, 2000).

Table 1:The Number of NCTM Standards and Expectation

Content Standard	Standard	Expectations
Number & Operations	3	12
Algebra	4	8
Geometry	4	12
Data Analysis	4	5
Measurement	2	8
Total	17	45

Validity and Reliability

To ensure validity, the instrument was given to a panel of five bilingual university professors of mathematics education, and elementary education to check the clarity of items and accuracy of the translation. Inter-coder reliability was checked by comparing the analysis of both researchers to each other using the Holsti equation (1969), and was found to be 0.93, which indicates a high reliability measure among the two raters. Holsti (1969) provided a basic formula for determining reliability, which is C.R. = 2M/N1 + N2, where "M is the number of coding decisions on which the two judges are in agreement, and N1 and N2 refer to the number of coding decisions made by judges 1 and 2, respectively" (p. 140).

Procedure

The study followed this procedure:

- The NCTM (2000) standards were translated from English to Arabic language to be the instrument of the study .

- Bilingual professors reviewed both versions and confirmed the accuracy of the translation .
- Both researchers analyzed the two parts of the first grade textbook.
- The paragraph was chosen as the unit of analysis. The activity, example, question, and geometric shapes were analyzed each as a paragraph.
- Determine the categories of analysis that included all aspects of NCTM standards (2000).
- For each paragraph, every training activity or issue, or a problem and examples was listed.
- Both researchers' analysis was compared using Holsti's equation and a score was calculated.

Results and Discussion

The overall purpose of this study was to investigate the extent that mathematics textbooks for Jordanian first-grade students adhered to NCTM standards. In order to answer this central question, overall frequencies and percentages of NCTM standards in the textbook was calculated, see Table (2).

Table 2: Percentage of NCTM Standards Represented in the Textbook

Content Standard	Frequency	Percentage
Number & Operations	118	65%
Algebra	25	14%
Geometry	9	5%
Data Analysis	0	0%
Measurement	30	16%
Total	182	100%

Not surprisingly, the content standard Number & Operations holds about 65% of the overall standards; since the concepts related to numbers & operations form the foundation of the study of mathematics. This agrees with the National Research Council's Committee on Early Childhood Mathematics concern about the importance of numbers as mathematics experiences in early childhood settings (Cross, Woods, & Schweingruber, 2009). Also, agrees with Abed and Al-Absi (2015) and Al-Zubi, and Al-Obeidan (2014) study's finding.

Interestingly, the data analysis skill category was not represented in the textbook at all. The authors believe that perhaps rather than an oversight, this was intentionally left out of the textbook in an effort to prioritize fundamental ideas such as numbers and operations given the limited number of hours students study mathematics at this age.

Overall, findings revealed that this first grade reformed mathematics textbook was compliant with (31) indicators of NCTM standards, resulting in a compliance rate of 68%. Which means that the content did not achieve (14) indicators (32%) in the five areas of the content standards. Table (3) represents these results for each category.

Table 3: Availability of NCTM Content Standard Expectations in Mathematics Textbooks

Content Standard	Frequency	Percentage
Number & Operations	118	65%
Algebra	25	14%
Geometry	9	5%
Data Analysis	0	0%
Measurement	30	16%
Total	182	100%

More details on these findings are provided based on each research question.

First, In order to answer the first research question (to what extent is the representation of the NCTM standards incorporated in the content of the Jordanian first-grade mathematics textbook in terms of Numbers and Operations?), overall frequencies and percentages of NCTM standards in the Textbook were calculated. See Table (4). Table (3) and (4) show that the content of the reformed first-grade mathematics textbooks complied with (11) expectations out of (12) from the NCTM "number and operations" standard expectations, which indicates a 91% compliance rate. The "Understand and represent commonly used fractions, such as 1\4, 1\3, and 1\2" expectation was not presented in the reformed first grade mathematics textbook. However, the standard "understanding meaning of operations and how they relate to one another" represented 33.9%. This could mean that the reformed

textbook is concerned more with connecting and integrating concepts rather than having students practicing operations in an isolated manner.

Table 4: Percentage of NCTM "Numbers and Operations" Standards Represented in the Textbook

Standard	Expectations	Frequency	Percentage
Understand number, ways of representing numbers, relationships among numbers, and number systems	Count with understanding and recognizes "how many" in set of objects	11	9.32%
	Use multiple models to develop initial understandings of place value and the base-ten number system	8	6.78%
	Develop understanding of the relative position and magnitude of whole numbers and of ordinal and cardinal numbers and their connections	16	13.56%
	Develop a sense of whole numbers and represent and use them in flexible ways, including relating, composing, and decomposing numbers.	14	11.86%
	Connect number words and numerals to the quantities they represent, using various physical models and representations.	8	6.78%
	Understand and represent commonly used fractions, such as 1\4, 1\3, and 1\2.	0	0
Understand meanings of operations and how they relate to one another	Understand various meanings of addition and subtraction of whole numbers and the relationships between the two operations.	25	21.19%
	Understand the effects of adding and subtracting whole numbers.	14	11.86%
	Understand situations that entail multiplication and division, such as equal groupings of objects and sharing equally.	1	%0.85
Compute fluently and make reasonable estimate	Develop and use strategies for whole-number computations, with a focus on addition and subtraction.	11	9.32%
	Develop fluency with basic number combinations for addition and subtraction.	8	6.78%
	Use a variety of methods and tools to compute, including objects, mental computation, estimation, paper and pencil, and calculator.	2	1.69%
		118	100%

The second research question (to what extent is the representation of the NCTM standards incorporated in the content of the Jordanian mathematics textbook for the first grade in terms of Algebra?) was answered by finding overall frequencies and percentages of NCTM standards in the textbook. See Table (5).

Table 5: Percentage of NCTM Standards of Algebra Represented in the Textbook

Standard	Expectations	Frequency	percentage
Understand patterns, relations, and functions.	Sort, classify, and order objects by size, number, and other properties.	6	24%
	Recognize, describe, and extend patterns such as sequences of sounds and shapes or simple numeric patterns and translate from one representation to another.	2	8%
	Analyze how both repeating and growing patterns are generated.	2	8%
Represent and analyze mathematical situations and structures using algebraic symbols	Illustrate general principles and operations, such as commutativity, using specific numbers	2	8%
	Use concrete, pictorial, and verbal representations to develop an understanding of invented and conventional symbolic nations	7	28%
Use mathematical models to represent and understand quantitative relationships	Model situations that involve the addition and subtraction of whole numbers, using objects, pictures, and symbols.	5	20%

Standard	Expectations	Frequency	percentage
Analyze change in various contexts	Describe qualitative change, such as a student's growing taller.	1	4%
	Describe quantitative change, such as a student's growing two inches in one year.	0	0
		25	100%

As seen in the table, the concept of analyzing quantitative change in various contexts was not represented in the textbook. These concepts would help students promote pre-algebraic understanding. However, Table (5) shows that 28% of the algebra standards were represented through analyzing mathematical situations and structures using algebraic symbols. This is consistent with the idea that children at that age level need concrete, pictorial and various representations to help them develop abstract and symbolic concepts. Furthermore, Table (5) shows that the content of the reformed mathematics textbook for first-graders was compliant with (7) expectations out of (8) from, the NCTM's Algebra standard expectations; which indicates a 87% compliance rate for this category.

In order to answer the third research question (to what extent is the representation of the NCTM standards incorporated in the content of the Jordanian mathematics textbook for the first grade in terms of geometry?), overall frequencies and percentages of NCTM standards in the textbook were calculated. See Table (6).

Table 6: Percentage of NCTM Standards of Geometry Represented in the Textbook

Standard	Expectations	Frequency	percentage
Analyze characteristics and properties of two-and three-dimensional geometric shapes and develop mathematical argument about geometric relationships	Recognize, name, build, draw, compare, and sort two and three dimensional shapes;	4	44.45%
	Describe attributes and parts of two-and three dimensional shapes;	0	0
	Investigate and predict the results of putting together and taking apart two-and three-dimensional shapes	0	0
Specify locations and describe spatial relationships using coordinate geometry and other representational systems	Describe, name, and interpret relative positions in space and apply ideas about relative position;	0	0
	Describe, name, and interpret direction and distance in navigating space and apply ideas about direction and distance;	0	0
	Find and name locations with simple relationships such as "near to" and in coordinate systems such as maps.	0	0
Apply transformations and use symmetry to analyze mathematical situations	Recognize and apply slides, flips, and turns;	0	0
	Recognize and create shapes that have symmetry	2	22.22%
Use visualization, spatial reasoning and geometric modeling to solve problems	Create mental images of geometric shapes using spatial memory and spatial visualization;	1	11.11%
	Recognize and represent shapes from different perspective;	1	11.11%
	Relate ideas in geometry to ideas in number and measurement;	0	0
	Recognize geometric shapes and structures in the environment and specify their location.	1	11.11%
Total		9	100%

Although geometry is a vital topic in elementary mathematics teaching, only five out of the twelve expectations in geometry were met. This indicates only a 41% compliance rate in terms of geometry.

To answer the fourth research question (to what extent is the representation of the NCTM standards incorporated in the content of the Jordanian mathematics textbook for the first grade in terms of measurement?), overall frequencies and percentages of NCTM standards in the textbook were calculated. See Table (7).

Table 7: Percentage of NCTM Standards of Measurement Represented in the Textbook

standard	Expectations	Frequency	Percentage
Understand measurable attributes of objects and the unites, systems, and processes of measurement	Recognize the attributes of length, volume, weight, area, and time;	8	26.67%
	Compare and order objects according to these attributes;	6	20%
	Understand how to measure using nonstandard and standard units;	1	3.33%
	Select an appropriate unit and tool for the attribute being measured.	1	3.33%
Apply appropriate techniques, tools, and formulas to determine measurements	Measure with multiple copies of units of the same size, such as paper clips laid end to end;	4	13.33%
	Use repetition of single unit to measure something larger than the unit, for instance, measuring the length of room with a single meterstick;	3	10%
	Use tools to measure;	5	16.67%
	Develop common referents for measures to make comparisons and estimates	2	6.67%
		30	100%

Table 7 shows that the content of the reformed mathematics textbook met all (8) NCTM expectations in the "measurement" category. This 100% compliance rate matches the same rate found by Alshehri and Ali (2016). It also shows that about 27% of the measurement standard was assigned for "understanding measurable attributes of objects and recognizing attributes such as length, volume, weight, area and time." This skill, in turn, builds the foundation for fundamental concepts of measurement in which children are provided ample opportunities to deal with daily-life situations where measurement is needed. This high percentage reflects the vital need to help children construct a foundational conceptual understanding of measurement.

Finally, in order to answer the fifth research question (to what extent is the representation of the NCTM standards incorporated in the content of the Jordanian mathematics textbook for the first grade in terms of data analysis and probability?), overall frequencies and percentages of NCTM standards in the Textbook were calculated. See Table (8).

Table8: Percentage of NCTM Standards of Data Analysis and Probability Represented in the Textbook

Standard	Expectations	Frequency	percentage
Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them	Pose questions and gather data about themselves and their surrounding;	0	0
	Sort and classify objects according to their attributes and organize data about the objects;	0	0
	Represent data using concrete objects, pictures, and graphs.	0	0
Select and use appropriate statistical methods to analyze data	Describe parts of the data and the set of data as a whole to determine what the data show.	0	0
Develop and evaluate inferences and predictions that are based on data	Discuss events related to students' experience as likely or unlikely.	0	0
Understand and apply basic concepts of probability.		0	0
		0	0

Table (8) makes it obvious that the "data analysis and probability" standard was totally neglected in the mathematics textbook. This result matches Abed and Al-Absi (2015) study's finding. This result is potentially justified because data analysis and probability skills first require a sufficient mathematical background, which is more than what young first grade students may posses. Therefore, the researchers recommend that a lesson fitting this category could be incorporated and integrated within the instruction of "numbers and counting" lessons, in which children will be asked to count and organize various data relevant to their daily experiences.

In sum, the NCTM state that students in first grade should develop deep foundational understanding of number and operation and should become proficient in using them to solve problems. The authors believe that

this happens when students are given ample opportunities and time to acquire an understanding of the structure of numbers in a flexible manner. In our opinion, this explains the focus of the new first-grade textbook on this standard and sub-categories. It further explains why the textbook does not contain a unit of Algebra, like in higher grades. However, around 14% of the textbook's activities complied with the NCTM standards of Algebra activities, including sorting, classifying and describing patterns. The authors believe that such activities help students develop the ability to solve various everyday problems.

Geometry and spatial reasoning was covered in only 5% of the reformed textbook, though the study of shapes and spatial reasoning offers students' capabilities that exceed their number sense and skills (NCTM, 2000). Further, the study of measurement, a topic related to Geometry, was covered in about 8% of the reformed textbook topics. According to NCTM (2000), Measurement activities can simultaneously teach important everyday skills as well as strengthening the knowledge of mathematics. : It is our belief that, despite only being covered 8% of the time in the text; the book does provide students with the necessary expertise to use various measurement systems and tools necessary for various applications of mathematics .

Conclusion and Recommendations

The overall purpose of this study was to investigate the extent that reformed Jordanian first-grade mathematics textbooks were compatible with NCTM standards. This study found evidence that the textbook analyzed was strong in some standards but was lacking in others. Also, the reformed mathematics textbooks neglected the data analysis and probability standard. The lack of compliance may have been on purpose or as a trade off for emphasizing other aspects. Overall, the study showed the textbook was compliant with (31) of the (45) indicators of NCTM standards. This resulted in a 68% compliance rate, which the authors consider inadequate representation. Although of analyzing, evaluation, and reforming mathematics textbooks from time to time, research has shown a lack of keeping up mathematics textbooks with the NCTM standards .

Many interesting implications arise from these findings. First, a suggestion for future research is to examine the NCTM Standards, taking those standards into consideration as well as involving some other variables. Of particular interest would be the textbooks of the other K-12 grades. In light of the results, this study recommends the following: conduct more studies in which both the content and process standards of the curriculum of the grades from kindergarten through twelfth grade would be analyzed. Further research could investigate the mathematics curriculum compared to the NCTM standards of 2006. These types of studies seem to be especially relevant in the first three grades, since these studies were rare in the literature.

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