

# Comparative Content Analysis of Mathematics Textbooks Taught to the First Grade Students of Elementary Schools in Iran, Japan and America

E. Reyhani <sup>\*†</sup>, M. Izadi <sup>‡</sup>

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## Abstract

The aim of the present research is to analyze, comparatively, the content of mathematics textbooks in the first grade used in Iran, Japan, and the United States, which has three analytic axes, namely: teaching and learning opportunities based on process and content standards of NCTM, assessment and practice opportunities and content treatment according to five grade coding (narrative expressions, mathematical expressions, pictures, shapes, tables and diagrams). The statistical population of this query was the content of mathematics textbooks in the first grade used in Iran (both old version and the recent one), Japan, and the United States (California State). This research was conducted based on comparative content analysis method in which qualitative and quantitative analyses were used for data collection and data analysis, respectively. According to the research findings, reasoning and proof standard was not treated in Japanese textbook as well as in the old and recent versions of textbooks used in Iran. Analysis of exercise and evaluation opportunities in the recent version of the Iranian textbook revealed that there was not any use of true-false questions. Therefore, the researcher's recommendations based on their findings are: 1) more emphasis on using numeric and algebraic expressions in the treatment of concepts; 2) increasing, significantly, the treatment of reasoning and proof standard; 3) using true-false questions in exercises and 4) using natural images in conceptualizations and transferring cultural contents.

*Keywords* : Teaching mathematics; Learning and teaching opportunities; Evaluation; First grade; Textbook.

## 1 Introduction

Textbooks are considered as a bridge between the intended curriculum and the im-

plemented curriculum. Concerning the status of textbooks, Howson [7] suggests that "mathematics textbooks in every country have observable effects on learning and teaching mathematics". Howson believes that in order to put a curriculum into effect in real conditions, textbooks can take into account the extent of perception of the specified purposes (the intended curriculum). Textbooks determine the boundaries of subject matters that are going to be taught and learnt

\*Corresponding author. e-reyhani@yahoo.com, Tel: +(98)9124501611.

<sup>†</sup>Department of Mathematics, Shahid Rajaei Teacher Training University, Tehran, Iran.

<sup>‡</sup>Department of Mathematics, Shahid Rajaei Teacher Training University, Tehran, Iran.

**Table 1:** Content and process standards of NTCM [16]

Domain	Standards	Standards goals
5*Content	Numbers and Operations	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; 3- compute fluently and make reasonable estimates.
	Algebra	1- Understand patterns, relations, and functions; 2- Represent and analyze mathematical situations and structures using algebraic symbols; 3- Use mathematical models to represent and understand quantitative relationships; 4- Analyze change in various contexts
	Geometry	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; 4- Use visualization, spatial reasoning, and geometric modeling to solve problems
	Measurement	1- Understand measurable attributes of objects and the units, systems, and processes of measurement; 2- Apply appropriate techniques, tools, and formulas to determine measurements
	Data Analysis and Probability	1- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them; 2- Select and use appropriate statistical methods to analyze data; 3- Develop and evaluate inferences and predictions that are based on data; 4- Understand and apply basic concepts of probability
5*Process	Problem-Solving	1- Build new mathematical knowledge through problem solving; 2- solve problems that arise in mathematics and in other contexts; 3- Apply and adapt a variety of appropriate strategies to solve problems; 4- Monitor and reflect on the process of mathematical problem solving
	Reasoning and Proof	1- Recognize reasoning and proof as fundamental aspects of mathematics; 2- Make and investigate mathematical conjectures; 3- Develop and evaluate mathematical arguments and proofs; 4- Select and use various types of reasoning and methods of proof
	Communication	1- Organize and consolidate their mathematical thinking through communication; 2- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others; 3- Analyze and evaluate the mathematical thinking and strategies of others; 4- Use the language of mathematics to express mathematical ideas precisely
	Connections	1- Recognize and use connections among mathematical ideas; 2- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole; 3- Recognize and apply mathematics in contexts outside of mathematics;
	Representation	1- Create and use representations to organize, record, and communicate mathematical ideas; 2- Select, apply, and translate among mathematical representations to solve problems; 3- Use representations to model and interpret physical, social, and mathematical phenomena

**Table 2:** The analysis form of teaching-learning opportunities in first grade math books according to content and process standards of NCTM

Domain	Standards	Tallies	Frequency
5*Content	Numbers and Operations Algebra Geometry Measurement Data Analysis and Probability		
5*Process	Problem-Solving Reasoning and Proof Communication Connections Representation		

(the implemented curriculum) and connect the intended curriculum - which is designed at a country or province level- to the implemented curriculum at the class level. Thus, it is necessary and valuable to analyze the differences in textbooks of different countries regarding their content and

their method of presentation. The importance of textbooks in the centralized educational systems, as Gooya [5] suggests, will be more evident if one consider that textbooks are the main source of teaching and learning for both teachers and students. Kiyamanesh [13] states that Iranian ed-

educational system is also centralized and teachers are asked to be loyal to textbooks. TIMSS<sup>1</sup> report (2007, stated in [20]) has revealed that more than 80 percent of teachers use textbooks as the main source of their teaching. A couple of observations that are obtained from some international tests such as TIMSS have shown that Iran was not successful in teaching mathematics at schools during holding these tests, and had no progress in this field [8]. One of the factors of this failure can be the content of Iranian textbooks. Content analysis helps the concepts, doctrines, attitudes, beliefs and all the components under consideration be analyzed in the form of the book lessons [27], and recognizes and introduces the weak points in the content of textbooks. Of course, text analysis requires doctrines and standards as a frame and basis to analyze textbook content. One of the most significant international criteria is "Principles and Standards for School Mathematics" which is published by the National Council of Teachers of Mathematics (NCTM). It seems that comparative content analysis among mathematics textbooks of Iran and countries which are forerunners of teaching mathematics based on NCTM standards would help authors of Iranian textbooks and other people involved in compilation and selection of textbook content.

Japan used to acquire scores above the international average in different international tests such as TIMSS and was always amongst the best countries [16]. On the other hand, most of the studies and researches in teaching mathematics have been accomplished in the United States. In America, curriculum and content of teaching mathematics are greatly based upon and informed by "Principles and Standards for School Mathematics" which is set by NCTM. Also, mathematics textbook of the first grade students in the elementary schools was changed in the academic year 2011-2012 after 28 years. In the present research, a comparative content analysis between mathematics textbooks published in Iran (the old and new ones), Japan and America is fulfilled based on the process and content standards of NCTM [16], because of the importance of the elementary school and its teaching content

and the significance of teaching mathematics to the first grade students, and its importance for higher academic grades. Also, to have a comprehensive analysis, we analyzed the exercises, evaluation opportunities and the manner of presenting subject matters in these textbooks.

According to the three axes put forth for this analysis, the research questions are as follows:

1. How are the learning and teaching opportunities in the content of mathematics textbooks of the first grade students in Iran, Japan and America are treated in view of the content and process standards of NCTM?
2. How are the exercises and evaluation opportunities for learning progresses in the content of mathematics textbooks of the first grade students in Iran, Japan and America treated?
3. How is the subject in mathematics textbooks of the first grade students in Iran (old and new), Japan and America according to fivefold codes (verbal expressions, numerical expressions, pictures, figures, tables and graphs) presented?

## 2 Literature Review

As far as the authors have investigated, there is not any research which has conducted comparative content analysis on mathematics textbooks of the first grade students in Iran, Japan and America. However, there are some studies about the content analysis of curriculum and mathematics textbooks in different academic grades, which have been done separately and with different methodologies in the above mentioned countries. Some of the studies will be mentioned hereunder.

Seyyed Mousavi [24] studied the content of the elementary school's mathematics textbooks based on the principles of curriculum development in Iran. She finally concluded that the vertical relationship in the content of the mathematic textbook of the first grade is appropriate.

Another research was done by Rezaei [20] which analyzed mathematics textbooks of Iran based on problem solving procedure. The statistical population of this research was all the mathematics textbooks in Iran. Findings revealed that apparent concentration of all the mathematics textbooks of the elementary school on improv-

<sup>1</sup>Trend international math and science study

**Table 3:** The analysis form of assessment opportunities available in first grade math books

Analysis axis	Classificatio	Tallies		Frequency	
2*Operation type	Individual				
	Teamwork				
2*Question compass	Open-ended				
	Close-ended				
7*Question compass	3*Objective	True-false			
		Matching			
		Multiple choice			
	3*Subjective	Essay			
		3*Short-answer	Essay		
			Completion		
Diagnostic					

**Table 4:** The analysis form of the manner of text presentation according to 5-fold encoding in first grade math books

Encoding type	Frequency	Tallies
Verbal expressions		
Numerical expressions		
Images		
Shapes		
Tables and diagrams		

**Table 5:** The analysis form of images based on virtual, natural and factitious images in first grade math books

Images Type	Tallies	Frequency
Virtual		
Natural real		
Unnatural real		

**Table 6:** Categories of content analysis of teaching and learning opportunities

Analysis type	Content					Process				
Floors	Numbers and Operations	Algebra	Geometry	Measurement	Data Analysis and Probability	Problem Solving	Reasoning and Proof	Communication	Connections	Representation

ing the calculation skills will get students away from learning mathematics. Also, the results in-

dicated that all the exercises in these books are nearly similar. So, because the heuristics are

apparent, these exercises cannot be regarded as problems. Having studied the extent of utilization of “problem solving” in general education, the author claimed that problem solving has a negligible or even a zero contribution in elementary schools, and due to the instability of this approach there will not be a desired result in the subsequent grades of education.

Following the recommendation of Organization of Research and Educational Planning, Kabiri [9] evaluated the newly compiled mathematics textbook of the first grade. He used multiple methodologies such as content analysis, getting feedback from specialists in teaching mathematics, curriculum development and textbook designers, interviews with teachers and leaders, observing class sessions, etc. By analyzing the variables which were in line with the specific purposes of curriculum development, the author concluded that around 19 cases out of 49 specific purposes of the first grade curriculum development were not considered anywhere within the chapters of the book. Specialists believe that this book has many weaknesses in the field of variables like issues of succession and prerequisites, so that out of the five indicators analyzed, only one index was scored as average, and the rest were recognized as being poor. Book review showed that there was not adequate cohesion in the texts. Also, findings revealed that the math book is not in line with the approaches of curriculum. After evaluating physical characteristics of the book, he concluded that specialists did not admit any of the indices of this variable to be appropriate. In addition, the depth of the book subjects and discussions had not an appropriate index. The index of using appropriate images showed that none of the indices were appropriate. Comparative analysis of the book based on the standards of teaching mathematics showed that the book cannot be considered as being consonant with teaching standards while teachers evaluated the book as being suitable both in its physical characteristics and its structural characteristics. They believe that the book exercises were designed according to students skills and the students will not face any serious problems in learning the presented concepts.

One of the most significant studies in the field of contrastive analysis between the secondary school curriculum of Iran, America, Australia, Singapore and Japan, is Karami Zarandi work [10] which is done comparatively by using Beredays Model. The research results indicated that although there are differences in approach and the manner of problem-solving processes in the curriculum of these countries, problem-solving is an indispensable part of the secondary school curriculum of teaching mathematics in these countries. By analyzing the function of problem-solving in the content of math books in these countries, the author concluded that although the Japanese textbook does not mention problem-solving approach in its curriculum, its textbooks are problem-based (Hino, 2007, mentioned in [19]). As Stacy (2005, mentioned in [19]) suggests, the United States has maintained the procedural purposes and problem solving approach. However, problem-solving in Iran’s math books has an insignificant role and is not set forth as the main purpose of teaching mathematics. After comparing the countries in terms of assessment methods, Karami Zarandi [10] realized that Iran has the greatest tendency to traditional methods of assessment, America being the second. It has been observed that in American schools the reliable and true skills and knowledge of students are measured using paper-and-pencil tests, the process which we are all familiar with. As opposed to America and Iran, there is emphasis on continuous tests, class activities and open-ended tests in Japan.

### 3 Research Theoretical Frameworks

3.1 Content and process standards of NCTM [16] In its most complete document, the National Council of Teachers published, in 2000, the standards of teaching mathematics at schools. There were 10 specified standards in this document for school’s math. These standards were divided into two categories, i.e. content and procedural. Based on this document, process standards are independent from different mathematical subjects but each of these standards rule all the mathematical subjects and all the educational

**Table 7:** Classification of assessment opportunities based on types of questions [22]:

7*Floors	3*Objective	True-false	
		Matching	
		Multiple choice	
4*Subjective	Essay		
	3*Short- answer	Essay	
		Completion	
		Diagnostic	

**Table 8:** Categories of content analysis and results analysis derived from text presentation axiom based on 5-fold encoding

Content analysis floors	Findings analysis floors
images	Pictorial half-imagined
shapes	2*Figurative half-imagined
Tables and diagrams	
Verbal expressions	2*Abstract
Numerical expressions	

grades from the preschool period to the 12th grade. Mathematical procedures are intertwined indispensably with mathematical act, doing and experiencing mathematics, thinking mathematically and producing and creating mathematics, so that mathematical thinking, producing and creating mathematics, real act, conceptual doing and true mathematical experience is not possible without them. It seems that mathematical subjects are like a skeleton and mathematical procedures are the soul of this body [16]. Table 1 shows these standards and their components.

### 3.1 Assessing Mathematics

One of the most important parts of the process of teaching and learning is assessment, which nowadays is treated differently than traditional perceptions towards it. Traditional view regards assessment as a means to gain information about the extent of reaching the predetermined purposes of teaching by the students (assessment of learning). This kind of assessment is answer-based and mostly uses paper-and-pencil tests [15]. Today, the concept of assessment has gone beyond the traditional approaches, so that it is considered as being dynamic and process-based and is present at all levels of teaching and learning. Assessment includes a set of different strategies for performance, such as journal writing, alternative

assessment, open-ended tasks and self-assessment [6, 12]. In this approach, assessment has three essential applications in the process of teaching and learning:

- 1- Assessment is a tool for being informed of the extent of learning the content and existing gaps between intended learning purposes and obtained successes.
- 2- Assessment for learning: assessment is a tool for the learner to be notified of the way he/she can develop his/her further learnings.
- 3- Assessment as learning: here, the learner uses assessment as part of his learning [2, 15].

## 4 Research Plan

As the present research is practical, it is both quantitative and qualitative. The quantitative methods used in this research include qualitative content analysis methods and the qualitative method includes analyzing the results. For analyzing the content of textbooks, comparative content analysis is used.

The authors have chosen Japanes first grade mathematics textbook which was published by Tokyo Shoseki in 2012 and California's first grade mathematics textbook which is published by Macmillan McGraw-Hill in 2009. The reason why the authors have chosen this textbook is that it is

**Table 9:** Results of content analysis of teaching and learning opportunities in the previously mentioned books based on NTCM standards

2*Domain	2* Standards	Iranian new book		Iranian old book		Japanes book		American book	
		Frequency	Frequency percentage	Frequency	Frequency percentage	Frequency	Frequency percentage	Frequency	Frequency percentage
5*Content	Numbers and Operations	534	54/21	741	57/17	315	64/95	682	40/48
	Algebra	323	32/49	440	33/95	142	29/28	702	28/93
	Geometry	47	4/77	70	5/4	10	2/06	136	5/6
	Measurement	68	6/9	28	2/16	12	2/47	378	15/58
	Data Analysis and Probability	13	1/31	17	1/31	6	1/24	228	9/39
5*Process	Problem Solving	19	1/86	6	0/5	17	3/6	202	8/16
	Reasoning and Proof	0	0	0	0	0	0	42	1/69
	Communication	209	20/49	76	6/35	42	8/9	273	11/03
	Connections	4	0/39	11	0/92	13	2/75	113	4/56
	Representation	788	77/25	102	92/21	400	84/75	1845	74/54
Number of pages		175		164		115		464	

the most applicable textbook in Japans schools. Also, the authors used the above-mentioned book in California because of its availability and as well as because three specialists in curriculum development and teaching mathematics had suggested it. The first grade mathematics book was changed after 28 years in the academic year 2011-2012. Therefore, the authors have used both the old math book (published 2010-2011) and the new one (published 2011-2012). The sample size is equal to the population size. Accordingly, the statistical population of the present research is as follows:

- 1- The first grade math book of Iran [3] which contains 164 pages and 8 chapters.
- 2- The first grade math book of Iran [21] which contains 175 pages and 24 tablets.
- 3- The first grade math book of Japan [4] which contains 157 pages and 13 chapters.
- 4- The first grade math book of America [1] which contains 464 pages and 14 chapters.

**Research tools:** Content analysis of self-made form (Tables 2, 3, 4 and 5) according to the analysis axes.

**Reliability of tools:** All categories specified in the present analysis have definitions that are approved by experts and researchers in teaching mathematics. On the other hand, the formal validity of the categories is done and the self-made form is approved by three professors of mathe-

tics teaching and two professors of curriculum development.

## Method of research implementation

Given that the present research has three separate analysis axes, namely, teaching-learning opportunities in first grade math books according to content and process standards of NCTM, practice and assessment opportunities and the manner of text presentation according to 5-fold encoding in first grade math books, the process of analyzing each axiom will be expressed separately.

In analyzing teaching-learning opportunities in the first grade math books according to content and process standards of NCTM, the analysis categories based on content standards are:

1-Numbers and Operations, 2-Algebra, 3-Geometry, 4-Measurement and 5- Data Analysis and Probability. Also, the analysis categories based on procedural standards are: 1-Problem Solving, 2-Reasoning and Proof, 3- Connections, 4-Communication and 5-Representation. It is worthy of notice that these two kinds of categorizations are not in a row. So, here, content analysis is done once according to content standards categorizations and once according to procedural standards categorizations (Table 6).

For comparative content analysis of the above-mentioned books based on the available assessment and practice opportunities, the authors used three kinds of content analysis with special categories. These analyses and categories include:

a) According to type of operation of assessment questions: here, questions are classified into two categories (individual and teamwork).

b) According to question type: here, questions are classified into two categories (open-ended and close-ended).

c) According to the question compass: here, questions are classified into objective and subjective questions and each category has some sub-categories which are specified and analyzed in Table 7. In analyzing the manner of text presentation based on 5-fold encoding, these categories include numerical expressions, images, figures, tables and diagrams. Here, regarding the importance of images in better presentation of concepts in this grade, the authors analyzed the book images based on the presented classification in Table 5.

The method of classification in each axiom of analysis was box method. Also, the unit of writing, lesson and field study was the whole book and frequency enumeration was used for counting. For data analysis in each analysis axiom, the descriptive method was used which includes frequency declaration, frequency percentage and comparing the findings derived from these four math books focusing mostly on Iranian new math book. Also, the authors separately compared the findings of the old and new math book of Iran to find the strengths and weaknesses of changing the content of Iranian math book. For analyzing the results derived from the manner of text presentation according to 5-fold encoding, the provided classification in Table 8 was used.

## 5 Research Findings

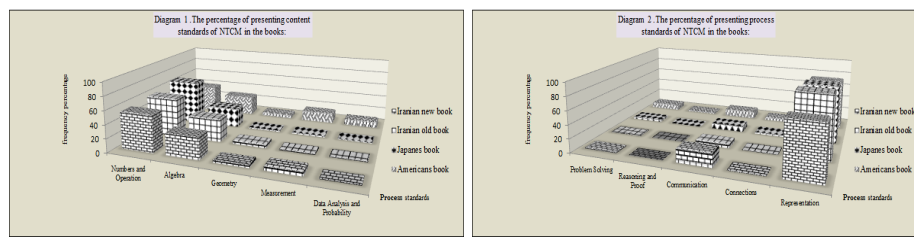
### 1. How are the learning and teaching opportunities in the content of mathematics textbooks of the first grade students in Iran, Japan and America are treated in view of the content and process standards of NTCM?

Table 9 presents all research results of this axiom. Also, Diagrams 1 and 2 show these findings visually. Table 10 also demonstrates the highest and the lowest percentages of presenting each standard in the books under discussion and the extent of differences in presenting each standard in Iranian old and new math books.

### 2- How are practice and assessment opportunities regarding learning progress in the content of Iranian (old and new), Japanese and American first grade math textbooks presented?

Table 11 provides all the results driven from this research axiom. In what follows, these results will be discussed. As it can be seen in Diagram 3, American math book has the most group assessment opportunities and Iranian new book has the least. Also, Iranian new book decreases around 0.76 percent in the type of assessment than its old version. In the open-ended questions, American book had the highest frequency and the textbook used in Japan received the least. Here, Iranian new book increased 8.65 percent than the old book. In objective and subjective questions, Iranian old book had the least frequency and Japanese book had the highest frequency of subjective questions. Rather than the old book, Iranian new book increased around 9.69 percent in frequency of subjective questions (Diagram 3). Also, Table 12 shows the highest and the lowest percentage of presenting group assessment opportunities, open-ended and subjective questions and the extent of differences in presenting each kind of assessment opportunities in Iran's new book with the highest percent of presenting and the percent of presenting opportunities in the old book.





**Table 10:** Comparing the percentage of presenting each kind of assessment in the aforesaid books

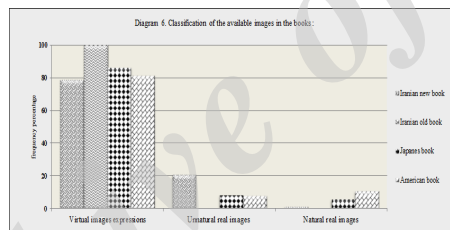
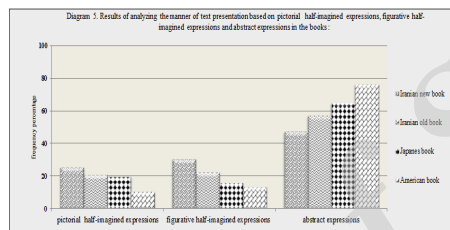
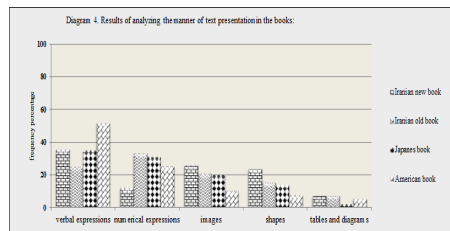
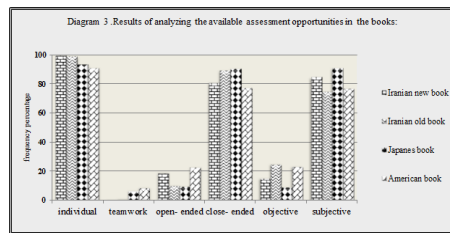
Domain	Standards	The most percentage	The least percentage	Differences in percentage of Iranian new book with the most percentage	Differences in percentage of Iranian new book with the old one
5*Content	Numbers and Operations	Japanes book	American book	10/57	-2/97
	Algebra	Iranian old book	American book	1/46	-1/46
	Geometry	American book	Japanes book	0/83	-0/63
	Measurement	American book	Iranian old book	8/68	+4/74
	Data Analysis and Probability	American book	Japanes book	8/08	0
5*Process	Problem Solving	American book	Iranian old book	6/3	+1/36
	Reasoning and Proof	American book	Japanes book, Iranian new and old books	1/69	0
	Connections	Iranian new book	Iranian old book	-	+14/14
	Communication	American book	Iranian new book	4/17	-0/53
	Representation	Iranian old book	American book	14/97	-14/97

**3. How is the subject in mathematics textbooks of the first grade students in Iran (old and new), Japan and America according to fivefold codes (verbal expressions, numerical expressions, pictures, figures, tables and graphs) presented?**

Research findings illustrated that in verbal expressions, American book has the most and Iranian old book has the least area of presentation. In numerical expressions, Iranian old book and Iranian new book had the most and the least level of presenting images, respectively. Iranian new book had the most level of presenting images, while American book occupied the last rank. In presenting figures, Iranian new book and in presenting diagrams and tables, Iranian old book had the most level of presenting figures. The least level of presenting figures is related to American

book and the least level of presenting diagrams and tables is for Japanes book (Table 13 and Diagram 4).

In analyzing the manner of text presentation based on pictorial half-imagined expressions, figurative half-imagined expressions and abstract expressions, the authors realized that Iranian new book has the most level of text presenting pictorial half-imagined expressions and American book has the least. In figurative half-imagined expressions, Iranian new book and American book received the most and the least levels of presentation respectively. The American book had the most level of using abstract expressions for text presentation, while Iranian new book had the least usage (Table 14 and Diagram 5). Data analysis showed that although Iranian new book uses more pictorial half-imagined expressions rather than other books, only 0.96 percent of the images are real natural images and the rest are vir-



tual images or unnatural real images. American book had the highest level of using natural real images and the old textbook used in Iran had the lowest level by using 0.00 percent of real images (Table 15 and Diagram 6).

## 6 Discussion and Conclusion

The purpose of conducting this research is a comparative analysis first grade math books taught in Iran, America and Japan in order to offer suggestions for improving the content of our country's textbooks. In the present research, comparative content analysis is used. Data analysis revealed that there are outstanding points in each book that can be applied to improve the content of Iranian math book. The most noticeable feature of Iranian old version of the first grade math book is the presentation of numerical expressions. The Japanese textbooks outstanding feature is present-

ing subjective assessment opportunities and in America is presenting proof and reasoning standard, open-ended assessment opportunities and natural real images. Table 16 shows the similarities and differences of these country's textbooks and the most striking characteristics of each of these books regarding the research axioms. The research findings revealed that the extent of presenting proof and reasoning standard in Iranian new book is the same as Iranian old book and Japanese book i.e. it is 0.00 percent and just in the American textbook this standard has been used for text presentation (Figure 1). However, many of the experts in mathematics teaching believe that the process of reasoning and proof is essential for recognizing and performing mathematical activities and that it is regarded as one of the most important tools in teaching and learning mathematics [14, 16]. As regards the importance of this tool, NTCM [16, p.56] declared that: "Rea-

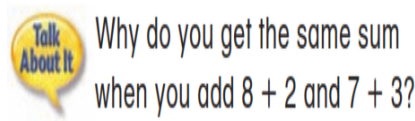


Figure 1: A sample of presenting proof and reasoning standard in American first grade math book (page 70)

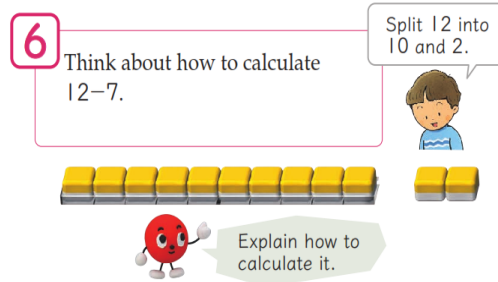


Figure 2: A sample of presenting opportunities in Japanes first grade math book to develop communication and explaining power in students (page 110)

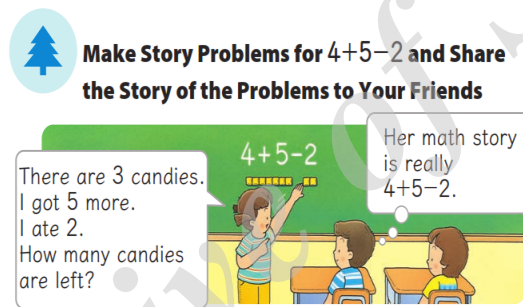


Figure 3: Usage of group assessment in Japanes math book (page 90)

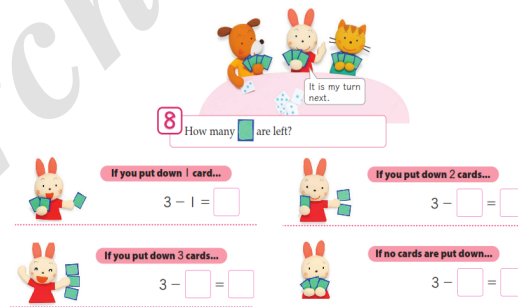


Figure 4: A sample of using numerical expressions in Japanes math book (page 57)

soning and proof should be a consistent part of student’s mathematical experience in prekindergarten through grade 12 [...], it must be developed through consistent use in many contexts”. Also, Usiskin (1994, as mentioned in [14]) believes that whatever the cultural background of the students is, usage of inductive methods and conscious intellection on them should be a significant part of teaching for all the students from the first grade

of school.

It should also be noted that although this standard is not mentioned anywhere in the book, teachers are asked in the teaching guidebook to teach in some occasions based on this standard. Although in the Japanese book there is not a direct reference to proof and reasoning standard, some opportunities have been provided for the students to strengthen required skills for this

standard, one of which is communication and explaining skill. In some cases, students are asked to reinforce this skill in themselves (Figure 2).

Results of analyzing available opportunities for practicing and assessment in Iranian new math book indicated that this book has the lowest level of using group assessment, as opposed to other three books, and that the old book faces a downward trend in the extent of presenting this kind of assessment. However, Japanese math book regards this kind of assessment as a tool for creating interest in mathematics and stimulating the students' creative activities in math using participatory activities, because it is during this kind of activity that learning takes place (Figure 3) [25]. Results of studying available opportunities for practicing and assessment in Iranian new math book revealed that this book has not used true-false questions. Due to the fact that the available assessment opportunities in every book should be in a way that all the levels of knowledge and skills in students about any intended concept can be assessed, all kinds of assessment questions should be included to assess all the levels of learning properly.

Findings revealed that Iranian new math book presents most of the concepts by using pictorial half-imagined expressions and figurative half-imagined pictures and that out of 47.24 percent of presenting abstract expressions, only 12.19 percent is related to numerical expressions and the rest, i.e. 35.05 percent, is related to verbal expressions (Table 12). However, in other three books, the extent of text presentation of numerical expressions is over 20 percent. These expressions in Japanese curriculum are called *shiki*, that in addition to expressions and equations like  $3+5$ ,  $x-4$ ,  $\square +3$ ,  $3+5=8$ ,  $x-4 =7$ ,  $\square +3=7$ , includes essay (short-answer) like  $x+5 > 2$ . Japanese curriculum lays stress on writing and interpreting these expressions as the main focus of quantitative relations. Also, one of the curriculum purposes of this country in this field is to perceive and to develop the content of other mathematical fields by using ideas and methods that are related to these expressions (Figure 4). These expressions are the starting point of the "algebra science" in mathematics. Many studies show the significance of using these expressions in elemen-

tary schools [26, 17, 23]. Thus, both Japanese curriculum and NTCM have a special emphasis on some aspects of the elementary school mathematics which is related to algebra and numerical expressions [16, 26]. According to what mentioned earlier, a question is brought up here: Does the improper use<sup>2</sup> of numerical expressions in Iranian new book text presentation leads to problems in proper text presentation and learning important mathematical concepts (like addition and subtraction)? Although final decision in this case requires more studies, preliminary analyses and the available theoretical foundations in this field indicate that learners will face such problems encountering this book.

Analyzing the manner of presenting content based on pictorial half-imagined expressions, figurative half-imagined expressions and abstract expressions in the new version published in Iran revealed that only 0.96 percent of the available images in the book are natural real images and the rest (99/04 percent) are virtual or unnatural real images. Images are one of the most important elements of transferring concepts through student's visual senses. Therefore improper use of this element may lead to improper text presentation and problems in transferring images to the student's visual mind. So, the extent of presenting natural real images in this book should be reviewed.

According to the research findings, the authors present the following suggestions for improving Iranian first grade math book:

1. More usage of numerical and algebraic expressions in presenting concepts
2. Noticeable increase in presenting proof and reasoning presentation
3. More usage of group assessment and true-false questions in this book for practice and assessment, and
4. Using natural real images for presenting concepts and transition of cultural bases. It should be noticed that the content of each country's textbooks is affected by many factors like cultural and native bases, overall policies, general purposes of teaching, the place of textbooks in curriculum development, etc. To change and modify the content of each textbook, it is urgent to first change

<sup>2</sup>Proper use means at least an average rate in other three books that is 30 percent.

the affective factors that have created them. Finally, regarding the wide span and importance of this subject, the authors offer some suggestions for further studies:

1. The same study can be done for other grades regarding the differences in textbooks.
2. Studying whether or not the photos available in the new mathematics textbook is suitable for presenting the concept.

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Ebrahim Reyhani is an Associate Professor of Mathematics Education at Shahid Rajaee Teacher Training University (SRTTU), Tehran, Iran. He received his M.Sc degree in Beheshti University, Tehran, Iran and received PHD in Moscow State University, Russia. His research interests includes Mathematics Teacher Education, Problem solving and problem posing in mathematics Education, Comparative Studies in Mathematics education, Students misconception in Mathematics and TIMSS study.



Mehdi Izadi is a M.Sc in Mathematics Education. He received his BS degree of Mathematics Education in July 2009 from Farhangian University, Shariati Branch, Sari, Iran, and his MSc degree of Mathematics Education in January 2013 from Islamic Azad University, Science and Research Branch, Tehran, Iran.

**Table 11:** Results of analyzing the available assessment opportunities in Iran (old and new), Japan and American first grade math book

2*Analysis axis	2* Classification	Iranian new book		Iranian old book		Japanes book		American book			
		Frequency	Frequency percentage	Frequency	Frequency percentage	Frequency	Frequency percentage	Frequency	Frequency percentage		
2*Operation types	Individual	955	99/58	109	98/82	368	93/49	2104	91/16		
	Teamwork	4	0/42	13	1/18	26	6/6	204	8/84		
2*Question compass	Open-ended	184	19/06	115	10/41	38	9/57	512	22/8		
	Close-ended	781	80/94	989	89/59	359	90/43	1734	77/2		
7*Question type	3*Objective	True-false	0	0	0	0	0	6	0/27		
		Matching	98	10/29	229	20/55	26	6/75	155	6/94	
		Multiple choice	48	5/04	50	4/48	9	2/33	359	16/08	
	4*Subjective	Essay	4	0/42	11	0/98	7	1/8	117	5/24	
		3*Short-answer	Essay	289	30/35	23	2/06	148	38/44	323	14/47
			Completion	513	53/88	801	71/9	195	50/64	1272	56/99
	Diagnostic	0	0	0	0	0	0	0	0		

**Table 12:** Comparing the percentage of presenting each kind of assessment in the aforesaid books

2* Kind of assessment	The most percentage	The least percentage	Differences in percentage of Iranian new book with the most percentage	Differences in percentage of Iranian new book with the old one
Group	American book	Iranian new book	8/42	- 0/76
Open-ended answers	American book	Japanes book	3/74	+ 8/56
Subjective	Japanes book	Iranian old book	6/25	+ 9/7

**Table 13:** Results of analyzing the manner of text presentation in Iran (old and new), Japan and American first grade math book according to 5-fold encoding:

2*Kind of encoding	Iranian new book		Iranian old book		Japanes book		American book	
	Frequency	Frequency percentage	Frequency	Frequency percentage	Frequency	Frequency percentage	Frequency	Frequency percentage
Verbal expressions	660	35/05	613	24/59	470	34/ 71	3767	51/3
Numerical expressions	251	12/19	812	32/ 58	407	30/05	1832	24/95
Images	522	25/35	512	20/54	265	19/57	764	10/41
Shapes	481	23/36	378	15/16	184	13/ 58	583	7/95
Tables and diagrams	145	7/04	177	7/1	28	2/06	396	5/39

**Table 14:** Results of analyzing the manner of text presentation in math book of the three countries

2*Kind of encoding	Iranian new book		Iranian old book		Japanes book		American book	
	Frequency	Frequency percentage	Frequency	Frequency percentage	Frequency	Frequency percentage	Frequency	Frequency percentage
Pictorial half-imagined	522	25/35	512	20/54	265	19/57	764	10/41
Figurative half-imagined	626	30/4	555	22/26	212	15/64	979	13/34
Abstract	911	47/24	1425	57/17	877	64/76	5599	76/25
Number of pages	175		164		115		464	

**Table 15:** Classification of the available images in Iranian, Japanese and American first grade math book

3*Book	3*Number of pages	3* Number of images	2*Virtual images		Real images			
					Natural real		Unnatural real	
			Frequency	Frequency percentage	Frequency	Frequency percentage	Frequency	Frequency percentage
Iranian new book	175	522	410	78/54	5	0/96	107	20/5
Iranian old book	164	512	512	100	0	0	0	0
Japanes book	115	265	228	86/04	15	5/66	22	8/3
American book	464	764	622	81/41	82	10/73	60	7/86

**Table 16:** Similarities and differences of the aforementioned books based on the research axioms.

Book characteristics	Iranian new book	Iranian old book	Japanese book	American book	The most similarities	The most differences
learning and teaching opportunities	Numbers and operations, representation	Numbers and operations, representation	Numbers and operations, representation	Numbers and operations, representation	Numbers and operations, representation	Measurement, connections
Exercise and evaluation opportunities	Individual	Individual	Individual, subjective	Open- ended	Individual	Open- ended
Manner of presentation	Verbal expressions, Half-imagined expressions, Unnatural real images	Numerical expressions, Half-imagined expressions, Virtual images	Verbal expressions, Abstract expressions, Virtual images	Verbal expressions, Abstract expressions, Natural real images	Verbal expressions, Virtual images	Numerical expressions, Natural real image