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Comparative Analysis of Math Curriculum in 4th Grade of Primary Education in Iran with the Pioneer Countries of TIMSS

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ABSTRACT

Performance of primary students in mathematics among the countries participating in TIMSS is different. The purpose of this study is to compare the math curriculum of Iran with the five countries which were the pioneers in TIMSS 2015 (Singapore, Hong Kong, South Korea, Taiwan, and Japan). The research method was comparative and the statistical population consisted of all math books of the fourth grade in Iran and the leading countries. The findings showed that some elements are similar among the countries, such as the concepts of numbers, calculation, measurement, and geometry. However, the studied curricula are different from each other, regarding skill of math problem solving, analysis and application of mathematical topics, interesting statistics and algebra topics, and positive attitude to math learning, so that in Iran these areas have been somewhat neglected. At the end, some suggestions were offered based on the findings.

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1. Introduction

In schools today, many students and teachers find math to be a difficult subject, and parents are often sensitive to it and are following their children's progress in the course. In the meantime, the Trends in International Mathematics and Science Study (TIMSS) is underway, one of which is primary fourth grade mathematics and is mainly run once every four years. This test is one of the most important studies in the field of quantitative evaluation, conducted by the International Association for the Evaluation of Educational Achievement (IAE).

Iran has also begun its work with the IAE since 1991 (Karimi, Bakhshalizadeh, Kabiri, 2012) and has participated in all six TIMSS studies and one advanced TIMSS study in 2008 (Kabiri, Karimi, Bakhshalizadeh, 2016). The results of Iranian students in TIMSS tests from 2007 to 2011 show that the students' performance in elementary fourth grade mathematics had a 29-point increase. That is, Iran has risen from 402 in 2007 to 431 in 2011. But with the announcement of the TIMSS 2015 results, it was found that Iran had a stable score in fourth grade math from TIMSS 2011 to TIMSS 2015; that is, despite the change in fourth grade math books, Iran had a score of 431 in the same period as the previous time. In fact, it has not made much progress (TIMSS, 2015).

The problem is that based on the results of recent TIMSS, Iranian students have not performed well in the test, although they are often busy at school and at home. In the latest report, the results of the fourth-grade basic math test were announced in 2015, with the top five countries Singapore, Hong Kong, South Korea, China and Japan.

A review of the math status of Iranian elementary schools, according to the results of TIMSS studies conducted since 1995, shows that Iran has ranked 25 out of 26 countries in 1995; 22 out of 25 in 2003; 28 out of 36 in 2007; 43 out of 50 in 2011, and it was ranked 42 out of 49 in 2015. These results show that Iran's rank in mathematics is lower than the world average. Overall, it was found that students in Kazakhstan, Turkey, Georgia, the UAE, Bahrain and Qatar scored higher in TIMSS 2015, compared to Iran. Post-Iran positions are also taken by countries such as Indonesia, Jordan, Saudi Arabia, Oman and Kuwait. Of the 41 countries that have been compared between 2011 and 2015, Iran is among the 15 countries whose average grade point has not changed much, but most of Iran's competitors are among the 21 countries that have reached the better level, in recent years (Iran's Science Watch, 2019).

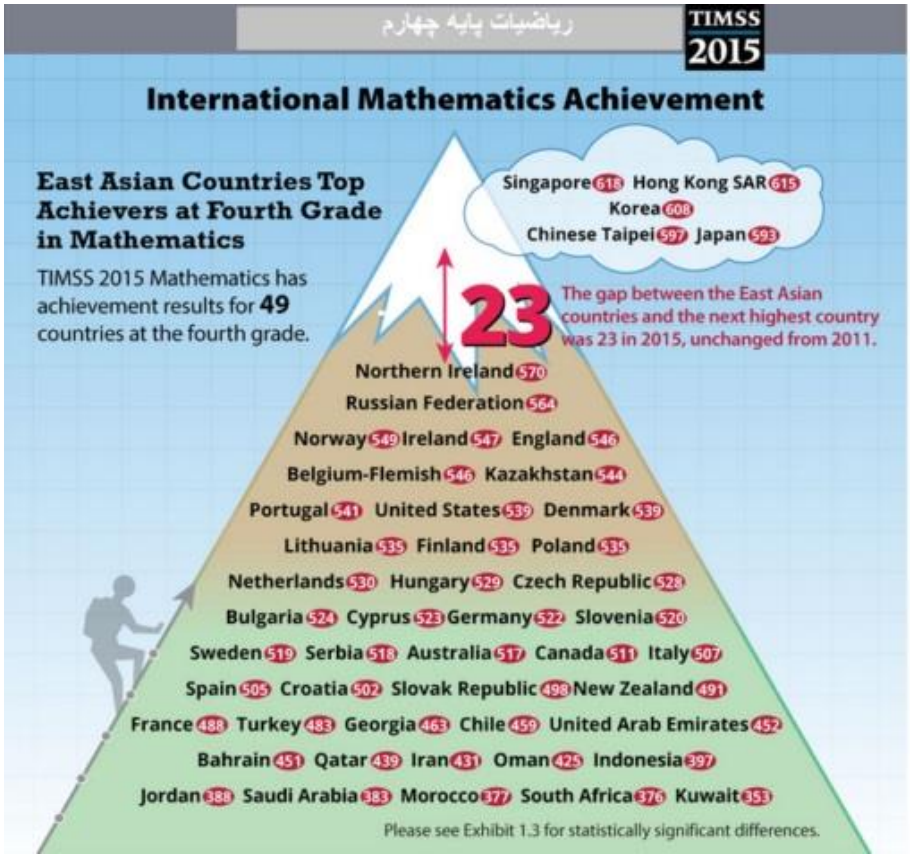

Figure 1. Results of TIMSS 2015, in 4th Grade Math (Iran's Science Watch, 2019)

One way of comparing countries is to conduct comparative studies, so that even comparing the performance of students from different countries in particular courses can provide real and strategic data for educational policymakers (Mirzakhani, 2009). So, the purpose of the present study is to compare the fourth grade elementary mathematics curriculum (in terms of purpose and content) with the leading countries in TIMSS 2015 (Singapore, Hong Kong, South Korea, Taiwan and Japan). Given some of the similarities and differences, and considering Iran's ranking in this international test, the study tries to propose some practical solutions.

In sum, the present study is an innovative research in terms of analyzing and comparing the math curriculum of the leading countries of TIMSS 2015 with Iran, so that the results can be obtained by the specialists and planners, textbook designers and teachers to use in action. Also the study can draw attention to the differences and possibly weaknesses in

math curriculum in Iran. In this regard, the present study seeks to answer the following questions:

1- What is the status of math education, goals and contents in 4th grade of elementary education in the selected countries?
2- What are the similarities and differences of math goals and contents among the selected countries?

2. Literature

The TIMSS test, as one of its parts, aims at measuring the mathematics performance in different countries and seeking to help the countries make informed decisions about improving mathematics teaching and learning. In the meantime, this test provides valuable information about the students' knowledge processes and skills in mathematics.

Some research has been done in different countries. For example, the study called "Analyzing and Modeling Mathematics Classes Based on PIZA Results in South Korea and Singapore" was conducted by Yi and Lee (2017). The results showed that the classroom behaviors and the perceived effects on students' learning are important. It was also found that the use of content-based teaching and less active cognitive strategies were positively associated with poor performance in mathematics, whereas the classroom with positive teacher management and teaching support had a positive relationship with students' better performance.

Kerr (2016) conducted a study titled "The Role of Students, Teachers, and School-Related Factors in Mathematical Progress: A Comparative Exploratory Study of Singaporean and American Students." The findings showed that the common characteristics affecting mathematical achievement for students in both countries include self-esteem, student academic background, and teacher confidence and confidence in mathematics education. The math progression factors for American students are more related to the curriculum whereas for the Singaporean students, they are more related to attitudes, expectations, and motivation. For the Singaporean students, the primary factor influencing mathematics performance plays a role in teacher dimension.

Another study by Serpil and Uykum (2013) was entitled "Parental Impact on Students' Mathematical Success: A Comparative Study of Turkey and TIMSS 2011 Leading Countries". In this study, South Korea, Singapore and Taiwan were selected as the top three countries in

terms of math scores for comparison with Turkey. The findings indicated that gender, parent-student relationships, computer access and internet were considered as important variables at student level. While the school context was seen as important variable at school level, the other factors such as family economy, background, and school climate were also critical. In addition, at the school level, the most important success factor in all studied countries was the socioeconomic status of the students.

In addition, another study called "Analyzing and Comparing the Content of Fourth Elementary Mathematical Books in Iran and Japan Based on Bloom's Cognitive Classification" was performed by Khademi (2015). The results showed that the content of math textbook was significantly different regarding the aspects of Bloom's cognitive domains. Also, the effect of attention to Bloom's cognitive levels on the content of the math books of Iran and Japan was prominent. In Iran, the root of mathematical weakness was due to factors such as the quality of books and the lack of linkage of some sections to students' previous learning, the uneven distribution of books in terms of Bloom's classification, and the lack of attention to high levels of math cognition. The results also showed that in books of both countries, the number of exercises, activities, and issues of high levels of cognitive domain, (namely composition and evaluation), was very low.

Kiamnesh, Aqdasi, and Mahdavi Hazawa (2014) showed that in the 2003 study, school atmosphere in Iran was less pleasant than other participating countries and the differences were significant. The school atmosphere in the 2003 study was inappropriate for fourth-grade elementary school students in Iran and other countries other than Armenia.

Another research was also conducted called "The trends in students' academic achievements in Thames studies in 18 countries" (Kiamanesh, 2013). The results showed that on one hand, there was a significant correlation between the mean scores of students' academic performance in 12 countries and on the other hand, academic self-concept, attitude to math, sense of belonging to school and school climate were critical. In most of the countries studied, the correlation between scientific self-concept and scientific achievement of girls was more than boys. Considering the situation in the countries that participated in two or three TIMSS studies, the mean scores of students' academic performance showed an improving situation. The rate of progress among Iranian students from 1999 to 2007 was lower than in four other countries. The improvement in the mean performance of girls and boys indicates that girls' achievements have been increasing more than boys. The results of student indices showed that students' "scientific self-concept" decreased and “attitude to math" improved.

Also, the two indicators of "sense of belonging to school" and "school atmosphere" remained unchanged. The observed results for teacher indices showed an improving situation. Comparing the performance of Iran with the more successful countries in the region, it can be clearly seen that the performance of Iranian students is less than that of other successful countries in the region.

The research findings of Erbas, Alacasi, and Bulut (2012) entitled "Comparing Textbooks in Turkey, Singapore, and the United States" revealed a variety of assumptions for student learning and preferred book designs. Singapore's textbooks reflected the simple features of text compilation and rich use of visual elements, fewer topics, and easier internal organization for better understanding. American textbooks were designed primarily as reference books. In the design of Turkish books, a sepecific method was used to create active learning for the students.

In addition, a study by Ginsberg, Leinwandn, Anstrom, and Pollock (2005) entitled "What the United States Can Learn from Singapore's Global Mathematics System: An Exploratory Study" showed that Singaporean students were more successful in mathematics than their US counterparts. They are, because Singapore has a world-class mathematics system, with a high-quality blend that nurtures mathematics-proficient students. This combination includes the rational structure of the National Mathematics Curriculum, rich mathematical problem textbooks, challenging mathematics assessments, and experienced teachers trained in rich educational centers.

3. Methodology

The present study is “applied” in terms of approach, “qualitative”, in terms of purpose, and is “comparative” in terms of method. In fact, George Bereday's approach is used to design similarities and differences based on John Stuart Mill's approach of difference.

In addition, the present study is "large" in terms of unit of observation and "conscious" in terms of sampling. The "different systems, same results" strategy has been applied. “Strategy of similar systems, same results" (including Singapore, Hong Kong, South Korea, Taiwan and Japan), and "Strategy of different systems, different results" (including Iran), meaning that all systems are assumed The educational settings studied differ in terms of cultural, social, political, and economic dimensions as well as the position of the educational system, and are therefore not expected to have the same results in terms of the variables under study (learners' performance in TIMSS).

The statistical population of the study consisted of math textbooks in fourth grade of elementary education in Iran and the pioneering countries of TIMSS 2015, (namely Singapore, Hong Kong, South Korea, Taiwan and Japan). In this regard, the curriculum documents from the selected countries were downloaded from reputable websites or obtained through correspondence with some school teachers in these countries, or some Iranian researchers in these countries. These documents were then translated and analyzed according to the purpose of the research in order to answer the main questions.

4. Results

4.1. Description and Interpretation

4.1.1. Iran

In Iran, the overall goals in mathematics are divided into three parts: knowledge, attitude and skill, each encompassing a broader range of smaller goals. The overall goal of math education is to provide the conditions for a person to acquire lifelong learning capabilities, as well as understanding definitions, symbols, conventions, and algorithms, which can be applied in three areas of skill, attitude, and knowledge (Reihani, 2016).

One of the courses that has recently undergone fundamental changes is the math curriculum in elementary education. Prior to this syllabus, "problem solving" was considered a learning outcome, but the recommended approach to teaching and learning in the new curriculum encourages teachers to engage students in problem solving in class or group activities that needs considering different learning styles.

The Ministry of Education's guidelines for emphasizing mathematics include mathematical content (basic facts and concepts), mathematical processes (problem solving, designing simple and real life situations, constructing hypotheses and evaluating them, estimating and reasoning), general skills of critical and creative thinking, observation, abstraction and generalization, comparison, sorting, and classification (TIMSS Encyclopedia, 2015).

On the other hand, some studies show that ignoring attitudinal goals is one of the challenges of math curriculum in primary schools in Iran. According to the latest changes in math textbooks, skill-based goals have received much attention. But, many students still lack the motivation and interest to learn math concepts and often find it to be a difficult course. A positive attitude to math and a spirit of truth-seeking, critique, and criticism of students require the attention and effort of all planners, textbook designers, and practitioners of mathematics to create for the learner a powerful tool for understanding and solving real-

world problems as well as makeing mathematical concepts more meaningful for them (Jafarikafiabad & Kian, 2015).

What is clear is that Iranian students in elementary school are less interested in math. If they have a good grade of math in their workbooks, it is not because of their motivation and love of math. In addition, the educational background of the primary teachers shows that a significant percentage of them have studied in humanities (not mathematics) and have low mathematical enthusiasm (Saffarian, Fallah & Mir Hosseini, 2010).

It seems that one of the difficulties, especially at the beginning of math learning, is the lack of understanding or misunderstanding of math concepts. In this regard, Alamalhodaei (2009) states that the most difficulties of mathematics for Iranian students are the non-standard teaching methods, the different learning styles of the learners. The teaching practices are often unrelated to the learners' cognitive level and unrelated to the classroom. Creating mathematical problems, means providing a chance for students to design math problems based on their knowledge and skills (Reihani, Gheibi, Eskandari, 2014). Mathematics problems and activities are another challenge (Seif, 2001). Students at school are faced with a type of mathematical problem that is not related to their actual lives (Yar Mohammadi, Vasel Rashidi, Bahrami, 2013).

According to some research, it has been found that the most common problems in elementary mathematics in Iran include insufficient attention to the use of applied methods, poor linkage of the content with the real environment, lack of attitudinal goals, weak mathematical background of teachers, insufficient in-service training, extreme use of pencil-and-paper tests to evaluate students' progress, and low level of math literacy of the students (Jafarikafiabad, Kian, 2015).

It should be noted that in the current Iranian educational system, due to the centralized approach, the textbooks play a major role in education (Reihani, 2016). Studies have also shown that elementary school students in Iran have been faced with many pitfalls in mathematical-processional problems (Bakhshalizadeh and Boroujerdian, 2013). When students are unable to make link between the previous and the new knowledge, or the new knowledge is insufficient, these pitfall links cause to systematic mistakes.

In order to move from simple math learning to deeper math understanding (such as math problem solving, reasoning, and math ideas communicating), the students should be encouraged to search more, make their ideas into clear language, and increase their self-esteem in math learning (Bakhalizadeh & Boroujerdian, 2013).

Regarding the textbooks in Iran, (namely as the Teacher's Handbook), written by Gholami (2016), the mathematical objectives of the math course initially include a number of topics, including: numbers, knowledge of the language of mathematics, the ability to use math language to present observations, familiarize with geometric concepts by direct observations, discrimination of algebraic and geometric patterns, statistic and probability concepts, math history in Islam and Iran, and obtaining positive attitude to math as a useful science. The content of the fourth elementary mathematics book also contains seven chapters, which, in combination with the objectives, are summarized in the table below:

Table 1. Overview of the Goals and Contents of Math Curriculum in Iran (4th grade of elementary education)

	Contents	Goals
1	Numbers and Patterns	Comparison of Numbers and Extensions, Mental Imagination or Meaningful Numbers, Dividing Pattern, Multiplication Pattern, Introducing and Training Seven-Nine-Digits Numbers with Abacus, Place Value, Approximation and Addition and Process Subtraction.
2	Fraction	Solving Mixed Number Problems, Introducing Mixed Number Symbols with Different Representations, Comparing Two Fractions with Different Derivatives, Drawing Strategies
3	Multiplication and Division	Process and technical multiplication, double and one digit multiplication (conceptualization and place value table), area multiplication
4	Measurement	Answering questions related to angle and time using modeling and sub-problem strategy, comparing times with units of hours and minutes, and magnitude of each, introducing angle vertex and its sides, measuring relation with fraction and mixed numbers, approximation skill , Exact size with smaller units, reasoning in measurement, conversion of units into one another, relative expression in the concept of measurement.
5	Mixed Numbers	Longitudinal representation of numbers, fractions and mixed numbers on axis, simplification of numbers in calculations, conceptualization of decimal numbers using capacitance, centimeters and millimeters, reading and writing of numbers in decimal, exponential and numeric symbols, comparison of decimal numbers and Relation to deduction
6	Geometric Shapes	Introducing the right angle symbol, writing the symbolic relationship perpendicular, finding the angle, guessing and experimenting strategies, familiarizing with the Loose, Rectangular, Square properties according to the parallelogram properties, creating the ability to convert units into one another, calculating the environment and area, and The ability to detect them, the ability to calculate the area of geometric shapes by separating shapes.
7	Probability	Ability to draw a broken line diagram and analyze and interpret it, compare tables and graphs, familiarity with probability terms and their meaning, ability to correctly apply probability expressions.

4.1.2. Singapore

The Singaporean Math curriculum includes a set of 12-year curricula, from elementary to pre-university. Since mathematics is a hierarchical subject, higher concepts and skills are built on the concepts and fundamental skills and must be learned sequentially.

The syllabus is designed as a spiral, where concepts and skills in each content area (such as numbers and algebra, geometry, and measurement) are reviewed and built at each level to gain greater and deep understanding.

At the elementary level, the objective-visual-abstract perspectives are at the center of the educational concerns, whereby the teachers create activities through everyday experiences and meaningful contexts. Using the visual-objective representations, the teachers help the students understand the abstract mathematical concepts.

The Singaporean Ministry of Education is also moving towards subject-specific math specialization for elementary teachers by providing in-service training to develop mathematics content and skills and reviewing the in-service training program to enable the teachers to specialize (Encyclopedia of TIMSS, 2015).

The plan of "Skills in Information and Communication Technology (ICT)" is also prominent in Singapore's education system and provides guidance on how to apply ICT in education and learning.

Since 2008, electric calculators have been introduced in elementary schools in Singapore. Calculators are used in mathematics to enhance the teaching and learning process, and to enable students to concentrate on problem solving, rather than routine calculations. The use of calculators and other computing tools does not reduce the emphasis on mental and manual calculations.

It can be stated that we can also make greater use of information technology in our classrooms in Iran to create deeper learning in math. Using calculators is a good solution for short class times, so that more students don't waste their time finding answers, but rather solving problems. Mathematics education, using technology tools, also helps students perform complex calculations. The belief that technological aids contribute to a deeper understanding of mathematical concepts is seen in Singapore schools. Therefore, the use of calculators, computers, and educational softwares is recommended to help students understand mathematical concepts, principles, and rules.

In Singapore, the vision of the "Thinking Schools- Learner Nation" (or TSLN) has been promoted by the Ministry of Education. This view changed the educational system in 1997 and included changes in all aspects of education.

A summary of the goals and contents of Singapore's fourth-grade math curriculum is presented in Table 2:

Table 2. Goals and Content of the Singapore Fourth Grade Mathematics Curriculum

	Contents	Goals
1	Numbers and Algebra	Integers, fractions and decimals and four arithmetic operations (add, subtract, multiply, and divide). Calculation with Calculator/ Common Factor and Multiples/ Order of Numbers/ Approximation/ Estimation/ Percentage / Ratio/ Algebraic Expressions in a Variable
2	Geometry and Measurement	Measurement of length, mass, volume, time and angle/ area and circumference of triangle, square and rectangle, area and circumference of cubes and volume of cubes and properties of simple geometric shapes / one-dimensional geometric shapes / symmetry
3	Statistics and Probability	Image charts, bar charts, tables, linear charts, and circular charts (including interpretation and use of problem solving information)/ Averages

4.1.3. Hong Kong

In Hong Kong, the educational research committees conduct some studies. The professional development programs for the teachers have been done as comprehensive programs to promote professional participation, collaboration and communication with various stakeholders in school and organization management. In addition, in Hong Kong, the elementary school students are not taught by the public classroom teachers or other classroom teachers. The students are taught by the teachers of various subjects. This can help a lot in developing a positive attitude towards math in students. It can also help enrich as much as possible the mathematics resources and materials for elementary schools by encouraging the active participation of teachers, educators, individuals, and competent organizations by emphasizing the non-governmental sectors.

The current Hong Kong's math curriculum at elementary level was introduced in 2001 and 2002, respectively. In addition to emphasizing the importance of acquiring subject knowledge and skills, the math curricula were intended to help students develop general skills and positive attitude towards math, as well as emphasizing the proper use of information technology. Unlike in many parts of the world, Hong Kong's students in elementary schools are not taught by general education teachers, but are taught by specialized

teachers of various subjects. However, not all teachers are formally trained on the subject, especially at the elementary level, and mathematics is not always taught by specialist teachers (TIMSS Encyclopedia, 2015).

Summary of the goals and contents of the Elementary 4th grade Math Curriculum in Hong Kong is presented in Table 3:

Table 3. Goals and Contents of the 4th Grade Math Curriculum in Hong Kong

	Contents	Goals
1	Numbers	Understanding the sum of numbers Understanding the nature of numbers Learning fractions, decimal numbers and percentages
2	Shape and Space	Learning the concepts of angle Learning directions Understanding two-dimensional shapes Understanding 3D shapes
3	Measurement	Learning and applying the following concepts: Money/ Length/ Weight/ Area/ Perimeter/ Size/ Time/ Speed
4	Information Processing	Understanding statistics concepts such as graphs, bars, linear, etc
5	Algebra	Understanding Algebraic Signs and Equations

4.1.4. South Korea

South Korea's National Curriculum is being revised periodically to reflect issues such as new demands in various educational fields, the rapidly changing needs of society, and new frontiers in academic disciplines. Curriculum standards are used as the basis for educational content and textbook development.

The Modified Mathematics Curriculum was designed in 2009 as a series of courses through which students may acquire mathematical concepts, principles and rules, ability to observe and interpret phenomena occurring in the world, increase the ability to solve mathematical problems using mathematical reasoning and logical thinking.

Korea recognized the need for continuous improvement of the mathematics curriculum to provide students with rich experiences and related activities to foster the development of comprehensive mathematical thinking processes (TIMSS Encyclopedia, 2015).

A summary of the goals and contents of the fourth grade elementary school math curriculum in South Korea is presented in Table (4):

Table 4. Goals and Content of South Korea's Fourth Grade Mathematics Curriculum

	Contents	Goals
1	Numbers and Operations	– Learning five-digit numbers and above – Learning to add and subtract three-digit numbers – Learning multiplication – Split learning – Learning four arithmetic operations (addition, subtraction, multiplication and division) with natural numbers – Converting a mixed number to a standard fraction – Learning decimal numbers – Add and subtract fractions and integers
2	Shapes	– Learning the properties of geometric shapes – Understanding one-dimensional shapes – Understanding the components of a circle – Understanding the properties of triangles – Understanding the properties of squares – Understanding the properties of polygons
3	Measurement	– Learn units of time, length, volume, weight, angle – Estimation (shear rounding, incremental rounding, descending rounding) – Compare numbers (equal to or greater than, equal to or less than, greater than, less than)
4	Patterns	– Comet patterns – Patterns and similarities
5	Probability and Statistics	– Organize information – Bar, linear and broken charts

4.1.5. Taiwan

In Taiwan, for fourth grade students, there are 25 subject learning courses per week. In general, math courses last for 40 minutes a day. However, the program development committee at each school can adjust the learning courses for each subject, and the number of weeks in a semester to fit the curriculum and the student's needs (TIMSS Encyclopedia, 2015). The following table summarizes the goals and contents of the fourth grade elementary math curriculum in Taiwan (Table 5):

Table 5. Goals and Content of Elementary Fourth Grade Mathematics Curriculum, Taiwan

	Contents	Goals
1	Numbers and Quantities	Students are expected to perform mathematical operations skillfully with natural numbers to understand the concepts of time, distance, area, weight, volume, capacity and angles and the units used to measure them. To understand fractions and decimals, it is possible to refer to sets or general sections and use estimation strategies in computation, problem solving and computational analysis.
2	Geometry	In Grades 1 to 3, students learn to identify, discover, and manipulate geometric shapes. But at Grades 4 to 5, students are expected to express numerical relationships among geometric shapes.
3	Algebra	Students learn to solve problems using the symbol. In elementary school, students express relationships in equations and sentences, express algebraic numbers, and solve simple linear equations.
4	Probability and Statistics	This has a strong relationship with algebra as well as numbers. Students become familiar with the concept of probability, the interpretation of data, and the problem of statistics. In elementary school, students who manage this educational content are able to create and interpret simple statistics tables and circular diagrams.
5	Mathematical Relations	To encourage meaningful learning, it emphasizes the integration of the other four topics and the transfer of knowledge and mathematical reasoning from school to everyday life, as well as other topics such as science and technology.

4.1.6. Japan

There is a great deal of emphasis on "problem solving" in math teaching in Japan, but the curriculum document does not address this issue directly. At the same time, there is a similar theme in the document called "Mathematical Thinking". In addition, the publishers in Japan are required to publish books approved by the Ministry of Education. Although it is not named "problem solving" in the national curriculum, but the math textbooks are problem-focused (SarkArani, 2012).

Perhaps the conclusion that can be drawn from Japan is that the class activities are far more important than the program document that was written. There is always some kind of hidden informal curriculum running in the classroom, out of the eyes of the programmers.

In Japan, it is believed that mathematics is a mandatory goal in elementary school. Beginning with the revision of the mathematics curriculum in Japan in 1998, the math activities have become an important part of the curriculum goals for all classes.

In addition, at the elementary and junior levels, the goal is to enjoy mathematics, while at the secondary level, the goal is to foster creativity in mathematics.

The mathematics curriculum consists of three parts: general objectives for elementary and junior levels; goals and content for each degree; designing course headings (TIMSS Encyclopedia, 2015). The following table summarizes the goals and contents of the fourth grade elementary math curriculum in Japan (Table 6):

Table 6. Aims and Content of Elementary Fourth Grade Mathematics Curriculum, Japan

	Contents	Goals
1	Numbers and Calculations	– Understand decimal numbers and fractions and how the student can express integers using the decimal system. – Understand integers and the appropriate contexts to use – Understand division and extend the ability to divide integers correctly – Strengthen the ability to compute integers and extend the ability to use these calculations – In-depth understanding of decimal numbers, including addition, subtraction, multiplication and division of decimal numbers and the use of these calculations – In-depth understanding of fractions, including addition and subtraction of fractions with common denominators and the use of these calculations – Addition and subtraction, using Japanese abacus (Japanese: Asoroban).
2	Quantities and Measurements	– Understand the meaning of units of measure, area and also calculate the area of geometric shapes – Understand the units and measurements for angles, as well as how to measure angles
3	Geometric Shapes	– Understand flat or two-dimensional shapes (such as parallelograms), solid or three-dimensional shapes (such as flat planes) by observing their elements and examining the relationships between those elements – Identify elements and positional relationships between 2D and 3D geometric shapes through activities such as observing and designing these shapes
4	Mathematical Relations	– Representing and examining the relationships between two numbers or quantities, as they change simultaneously – Understand geometric demonstrations that represent the relationships between numbers or quantities and use these representations – In-depth understanding of the characteristics of the four basic mathematical operations – Collect and organize data by purpose; Show data clearly using – Tables and graphs, and examining data shapes

4.2. Adjoining and Comparison

After describing and interpreting the fourth grade elementary math curriculum in the selected countries, a comparative analysis is now performed to compare the similarities and

differences between these countries with Iran. It is worth noting that the summary of these similarities and differences is presented in Tables 7 and 8 below:

Table 7. Similarities of the Selected Countries

	Country	Similarities
1	Singapore	In both countries (Iran and Singapore): – The concepts of numbers, fractions, integers and multiplication and division and approximation are common and are taught. Also in the content area, there are concepts of geometry and measurement, including measuring length, time and angle, as well as learning the area of the triangle, square and rectangle, and learning the features of simple geometric shapes and simple one-dimensional shapes. – In the field of statistics and probability, both countries teach graph-related topics.
2	Hong Kong	In both countries (Iran and Hong Kong): – There are the concepts of numbers and sums of numbers, the nature of numbers, the fraction and integers, concepts of shape and space, angles and directions, concepts of money, length, weight, area, environment, time and volume and velocity, dashed graph. These are taught.
3	South Korea	In both countries (Iran and South Korea): – The concepts of multiplication, division, four functions of arithmetic with natural numbers (addition, subtraction, multiplication and division) are taught. – Addition, subtraction of fractions, addition and subtraction of integers are also taught. – Learning the properties of geometric shapes, understanding one-dimensional shapes, understanding the properties of squares and understanding the properties of triangles, estimating and approximating and comparing numbers and teaching patterns are available in the books.
4	Taiwan	In both countries (Iran and Taiwan): – Students are expected to perform mathematical operations with natural numbers. – Understand the concepts of time, distance, area, weight, and angles and the units used to measure them. – Understand fractions and decimal numbers – Use estimation strategies in computation, problem solving, and computation review – Understand numerical relationships among geometric shapes – Solve issues using the mark – Understand the concept of probability, data interpretation and statistics problem – Create and interpret simple statistical tables
5		in both countries (Iran and Japan): – Understanding decimal numbers and fractions and how integers can be expressed using the decimal system are found in mathematics textbooks.

	Japan	– Understand integers and the appropriate contexts to use – Understand the division and growth of the ability to divide integers and consolidate the ability to compute integers and extend the ability to use these calculations – Understand decimal numbers, including addition, subtraction, decimal numbers, and using these calculations – In-depth understanding of fractions, including addition and subtraction, fractions with common denominators, and the use of these calculations – Understanding units of measure and area and calculating area of geometric shapes / Understanding units and measuring angles – Understand planar or two-dimensional shapes (such as parallelograms) and solid or three-dimensional shapes (such as flat planes) by observing their elements; examining the relationships between elements, identifying elements, and situational relationships of two-dimensional geometric shapes – In-depth understanding of the characteristics of the four basic operations – Collecting and organizing data

Table 8. Differences of the Selected Countries

	Country	Differences
1	Singapore	– In Iran, the topics of volume, weight, as well as the circumference of the triangle, the circumference of the circle, the volume of cubes and the line of symmetry are not taught. – In Singapore, the emphasis is on learning graphs, bar graphs, tables, linear graphs and circular graphs (including interpreting and using information to solve the problem). – In Iran, only the "broken line chart" is taught. – In Iran, converting a mixed number to a conventional fraction is taught in fifth grade. – The goal of "interested students in mathematics" is among Singapore's educational goals. – In Singapore, independence in understanding and solving mathematical problems has been placed among mathematical goals.
2	Hong Kong	– Teaching the concept of "percent" in Iran is not taught in elementary fourth grade. – Three-dimensional forms are also not taught in the Iranian curriculum. – The concepts of volume and speed are not taught in the Iranian curriculum. – In the content of the Hong Kong curriculum, there are statistics, bars, lines in the statistical section, but in Iran, only the "broken line" chart is taught. – In algebra, the goals in the Hong Kong curriculum include algebraic signs and equations, which are not taught in Iran. – In Hong Kong, there is a focus on the ability to understand simple interpretations of mathematical relations in mathematics education goals, which is not in the curriculum of Iran.
3	South Korea	– In the Iranian curriculum, the topic of converting a mixed number to a conventional fraction is taught in fifth grade. – In Iran, the topics of polygon features and circle components are not taught. – In the South Korean curriculum, learning units of time, length, volume, weight and angle are available, but in Iran only the concepts of measuring time, length and angle are taught.

		– In the field of statistics and probability in the South Korean curriculum, there are concepts of organizing information and using and using diagrams, linear and broken line charts, in which the only "broken line" chart is taught in Iran. – The purpose of "Loving Mathematics" is in the curriculum goals of the South Korean curriculum. – In South Korea, the "ability to solve mathematical problems" is seen among the goals of mathematical education.
4	Taiwan	– In the Iranian curriculum, the concepts of volume and capacity are not taught. – In the Taiwan curriculum, the concepts of creating and interpreting circular diagrams are taught, but in Iran only "the broken line chart" is taught.
5	Japan	– The concepts of multiplication and division of numbers and addition and subtraction by abacus are not taught in the Iranian curriculum. – The curriculum of Iran does not teach the concepts of solid or three-dimensional shapes (such as parallelograms) by observing their elements and examining element relationships and element recognition, and the positional relationships of two-dimensional geometric shapes. – In Japan, "student independence in mathematical understanding and thinking" is among the goals of mathematics education. – In Japan, the "interest in math" goal, which is an attitude, can be seen in math education goals.

Based on the above table, the basic fourth grade math curriculum of Iran and the leading TIMSS countries have similarities and differences in some ways. For example, the similarities show that, in the pioneer countries, the students are usually expected to perform mathematical operations with natural numbers, and learn the concepts of time, distance, area, weight, and angles and units used to measure and understand them.

The differences also highlight the pioneering countries' emphasis on fostering a positive attitude towards mathematics, the ability to solve mathematics problems independently, as well as the ability to interpret simple mathematical relationships, which are less commonly seen among the goals of the Iranian curriculum.

5. Discussion and Conclusion

The results of Iranian students' performance in TIMSS from 2007 to 2011 show that Iran had a 29-point increase in elementary fourth grade math. In fact, that is from 402 in 2007 to 431 in 2011. But with the announcement of the TIMSS 2015 results, it was found that Iran had a stable score in fourth grade math from TIMSS 2011 to TIMSS 2015, meaning that despite the change in fourth grade math books, the TIMSS results also did not improve with a score of 431 during this period.

In the meantime, one of the steps taken by Iran to promote mathematical learning of the students has been to change the mathematics textbooks. Accordingly, this study aimed to compare the fourth grade math curriculum of Iran with the leading countries in TIMSS 2015. According to the findings of the first question, neglecting the attitudinal goals in math education in Iranian elementary schools is one of the most challenges. Although, according to the latest changes in math books in Iran the skill-based goals have received much attention as well as the knowledge-based goals, but is seems that it is not enough. Developing thinking skills, acquiring modeling and problem solving skills, and applying mathematical concepts to the environment, reasoning, and verbal communication are among the skills that have been taken into consideration; but these goals have not yet been fully realized in Iranian schools.

In addition, the attitudinal goals appear to have been neglected. Many students still lack the motivation and interest to learn the math concepts and regard it as a difficult course. In this regard, problems such as the traditional methods of math education, lack of content relevance to the real life, lack of attention to attitudinal goals in math curriculum, poor mathematics background of the teachers, weak pre- and in-service training, further use of pencil-and-paper evaluations to evaluate student achievement, and ultimately, lower students' mathematical literacy levels, could be grounds for such a situation in mathematics education of elementary schools in Iran.

In sum, this study showed some results. The findings are in line with some aspects of Khademi's research (2015), since the study showed that the content of the two book types in Iran and Japan was not significantly different in terms of levels of knowledge, application, analysis, composition and evaluation, but the content of Iranian textbooks was significantly different from that of Japanese textbooks in terms of level of math learning. The study also found that the books in Iran conform to the principles of the content organization and desirable textbook characteristics, while the reason for the students' poor learning is in the quality of the books themselves and the lack of linkage of some parts of the books with the students' previous learning.

In addition, other findings of the present study show that the status of mathematics education in the early years of the pioneer countries, including Singapore, is such that the Singapore's policies seek to develop the "Thinking Schools, Learning Nation" (TSLN) perspective. This policy has been developed in schools for many years.

In addition, the new policies were introduced in the new Hong Kong Elementary School Math Curriculum from 2002. In addition to emphasizing the importance of acquiring

subject knowledge and skills, the program emphasizes helping students develop basic math skills and a positive attitude towards math as well as the proper use of information and communication technology. Hong Kong's 2009 Math Curriculum also emphasizes mathematical process standards and pursues issues such as mathematical problem solving, communication and reasoning more prominently. According to the program, the math process not only requires useful teaching methods to improve students' understanding, but also should strengthen the students' deep understanding of the mathematical contents.

In Taiwan, the Ministry of Education has also been following some developments in mathematics teaching and learning. In 2001, the Ministry of Education announced that an elementary school information education program would be developed to encourage the use of information and communication technology in subject learning for elementary students.
On the other hand, although there are many references to "math problem-solving" in the Japan Curriculum, the booklet does not address this issue directly. However, in the document a similar issue is called "Mathematical Thinking", which places a great emphasis on the skill of understanding and mentally solving mathematical problems.

The results of the present study showed that most of the pioneering countries in TIMSS have had higher content quality, such as the attention to the concepts of volume and capacity, algebraic topics and a variety of statistical concepts, whereas the similarity of the math curriculum contents, especially between Japan and Iran, are more.

However, the findings of the present study are consistent with the results of the study by Erbas, Alacaci, & Bulut (2012), in that, both studies emphasize step-by-step formulation of subjects and easier internal organization of mathematical textbook content. This issue is particularly prominent in the organization of the Iranian and Singaporean math textbooks.

In addition, the findings of the present study are consistent with some aspects of the research by Ginsburg, Leinwand, Anstrom, & Pollock (2005), in that, the present study observed challenging assessments of math problems in math goals of Singaporean curriculum, and the research by Ginsburg, et, al. (2005) also highlights the importance of assessing math problems in Singaporean textbooks.

In addition, the present study is inconsistent with the findings of Kerr's research (2016). The present study provides some findings, such as the emphasis on different levels of cognitive goals, basic mathematical operations, and math content including fraction, numbers, measurement, problem solving, while in Kerr's research (2016) most of the teachers'

attributes and competencies, such as confidence in math teaching and student management in the classroom, have been considered critical.

The findings of the present study are also inconsistent with some of the results of Serpil & Oykum (2013) research. In the current study, the factors such as parent-student communication and use of educational technologies in deeper mathematical learning are considered as providing the learning environment, whereas in the findings of the present study fewer cases of this kind exist.

On the other hand, the findings of the present study are inconsistent with some aspects of Pakoskoei & Yari (2016) research, in that, the present study did not observe cognitive assessments of math problems in the math objectives of Iranian books, while the findings of the research in 2016, showed that UCMAS learning (Universal Concept of Mental Arithmetic System) is an important goal in math learning, as it improves problem-solving performance in children.

In addition, the findings of the present study are in line with some aspects of Tohidinejad research (2015), since the present study showed that Iranian math books showed a lack of attention to discussion and problem solving. Other findings of that study also focused on the background-based instruction and the increased students' math performance in cognitive domains, whereas the present study did not address these issues.

On the other hand, the findings of the present study are inconsistent with some aspects of Mahdavi Hazawe, Aqdasi, & Safarkhani's (2013) research, as it showed that in successful schools, objectification of education through attention to pre-organizers is an important goal of math learning.

The present study also had some limitations. For example, it was difficult to access all credible resources of the pioneer countries. The other limitations were lack of opportunity to interview with the teachers and experts in all pioneering countries, and to examine their views more closely on their country's math curriculum.

In sum, the findings of the study showed that Iran's fourth-grade elementary math curriculum is similar, in some respects, to the leading countries. However, these programs differ together, regarding attention to mathematical problem solving skills, analysis and application of mathematical topics, attractive topics of statistics and algebra, as well as the promotion of a positive attitude to mathematics, so that in the math curriculum in Iran, such discussions have received little attention.

Based on the findings, the present study proposes the following suggestions, in order to improve mathematical goals and contents and thus improve the students' math learning:

- Structural attention to the development of independent mathematical problem solving skills by integrating these skills into mathematical subjects in the fourth elementary math textbooks.
- Practical teaching of mathematical topics, through training the teachers how to teach mathematical issues close to the real life of children.
- Combining the fascinating topics of algebra and statistics, in simple language, in elementary fourth grade mathematics.
- Make children more interested in learning mathematics through in-service teacher training in attractive math teaching methods and conducting creative math workshops in schools, especially for the teachers, the students and their parents.

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