

A Comparative study of the grade 10 mathematic textbooks of in applied sciences-mathematics in Iran and grade 10 mathematic textbook in Canada

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ABSTRACT

Achieving pre-eminent education has always been a concern, and studying the working methods of pioneer countries can shorten the path to this success. The aim of the present study was a comparative comparison of Iranian and Canadian grade 10 mathematics textbooks in order to compare the mathematical literacy of the students of these two countries and the method of achieving it in this grade. This work has been done using the method of William Rumi and also the volume of these materials have been compared with each other. In addition, the exercises of these two books have been compared based on Bloom's cognitive domain. The statistical population of the study was two common topics in these two books (function and trigonometry) that have been thoroughly and completely studied. According to the research findings, the text engagement coefficient of this part of the books for the 10th grade Iranian Math textbook was 2.25, which was higher than the desired value (0.4 to 1.5) and indicated that the Iranian textbook was difficult. The text engagement coefficient calculated as 0.9 for the 10th grade Canadian Math textbook, which indicated that the 10th grad Canadian Math textbook was active and engaged students well. The volume of grade 10 Iranian Math textbook in these topics was a quarter of the Canadian Math textbook. The number of Canadian math textbook exercises in both subjects of function and trigonometry was 7 times more than that of Iranian Math textbook. The grade 10 Canadian math textbook exercises were designed to cover most of Bloom's cognitive levels, but the Iranian math textbook exercises were mostly at the level of comprehension and some at the level of application.

Keywords: Grade 10 Iranian Math Textbook, Grade 10 Canadian Math Textbook, William Rumi Content Analysis Method, Bloom Cognitive Levels

Introduction

One of the fields that leads to the growth of countries is education issue in that region, and by studying in this important field, solutions for progress can be obtained.

The current educational system of Iran is a centralized system and the textbooks are the same in the whole country (Mashayekh, quoted by Nik Nafs, 2013). Teachers use the textbook as the main source of content and the main teaching tool (Sikorova, 2011, quoted by Nourian, 2015).

Among these, math textbooks have an important impact on classroom practice (Okifi, 2014). They are also one of the key factors in the implementation of the mathematics curriculum and play a vital role in the classroom. Math textbooks have the greatest impact on math learning, and are recognized as a good indicator of students' learning opportunities. Math textbook problems serve as a window for researchers to explore students' opportunities to learn math (Yang, Tseng, Wang 2017).

Therefore, it can be said that textbooks play an important role in the education system, and by studying and analyzing the content of these texts and comparing them with other countries, we can find out about our strengths and weaknesses and take effective steps towards the development and progress of our beloved country. In this regard, using the experience of other countries in the field of education development can help us tackle problems so that the wrong way is not tested again, and this is done by comparative education and comparison of countries in this field.

On the other hand, because the subject of curriculum planning in the country is new, the development of educational programs, completion of textbooks, teaching methods and other measures are not based on comprehensive programs based on Islamic and Iranian culture. It has caused many damages and shortcomings (National curriculum, preface). So, the codification of document of fundamental transformation of education was considered in order to make changes in all aspects of the curriculum. Following this, the codification of curriculum as a comprehensive learning map provided the basis for a comprehensive, extensive and in-depth creation of educational concepts and content.

Revising the content of the textbook will lead to the growth and development of curriculum planning and, consequently, academic growth and development. Therefore, with the knowledge of the role and importance of textbooks in the development of education and due to the change of educational systems, it is necessary to evaluate textbooks and analyze their content. (Shaarinejad quoted by Niknafs, 2013).

Also, the results of low level of Iranian students in international exams, such as TIMSS (rank around 30), revealed the need to revise the curriculum in the country. These results showed that the level of performance of Iranian students was significantly lower than the international average (Isfahani, Hosseinifard, Naghizadeh, 2015). The third Trends in International Mathematics and Science Study (TIMSS) resulted in the examination of the shortcomings of mathematics textbooks (Schmidt et al., Quoted in Goya, 2002).

Students' low performance in mathematics is influenced by several factors. Among these factors, mathematics textbooks could be mentioned. According to the TIMS, the participants in this test have stated that they use textbooks as the most important source for their teaching to a large extent (Rafipour 2010, quoted by Maleki, 2016).

Ezdoghan (2007), quoted by Maleki (2016) stated that textbooks are an important tools for teachers in teaching mathematics and in planning for the class, planning the daily program and choosing classroom activities for them. Students also use textbooks to review what they have learned in the classroom and to do their homework. In this regard, the revision of textbooks will have beneficial effects on improving the educational situation in the country, and in this regard, familiarity with the textbooks of other countries is a necessity, especially countries that have good scores in international exams and are prominent in this field in the world. Comparing and expressing similarities and differences and analyzing the textbooks of these countries can help us to identify and diagnose problems and their causes. Without comparing the situation of mathematics education in Iran, it is natural for people to believe that the situation is the same everywhere in the world and the curriculum in other countries is similar to the curriculum in Iran (Goya 2002).

According to what has been said, education system in any country is a factor in the development of that country. For this reason, it is important for the authorities of any country to fix its defects. Using the

experiences of other countries for the development and applying it and its improvement methods and quality can increase our capabilities in tackling the problems. This will be possible with comparative education.

Therefore, the aim of this study was to review the tenth grade math textbook and compare it with the tenth grade Canadian math textbook, examine the content of the book in terms of student engagement, and compare the volume of these two books in terms of number of examples and exercises and their level based on Bloom cognitive levels.

Theoretical foundations of research

Textbook

The textbook is the most important learning tool and other teaching tools are beside it.

Each educational system seeks to use different educational tools and equipment to achieve its ideals and in this way uses different tools and media. In Iran, because of not valuing other educational methods, textbooks have a very important impact on the learning process.

UNESCO (2005) believes that textbooks and learning tools have the ability to transfer knowledge, develop skills and teach students how to interact with the world. Also important sources of information for all levels of education are classrooms, laboratories and social learning centers (Nourian 2018).

Textbooks are the focus of education officials because of their great importance in determining educational content and policy. The importance of textbooks in centralized educational systems such as Iran is more than other types of educational systems, and because of this excessive importance of textbooks, reviewing and analyzing them can help solve the country's educational issues.

Math textbook

Mathematics and its applications are part of daily life and can be used to solve life problems in various fields that have wide applications in various human activities. Mathematics will train people who can reason logically in dealing with problems, have the power to analyze and abstract, and build comprehensive theories about peripheral phenomena. The important aspect of mathematics is empowering human to accurately describe complex situations, predict and control possible materialistic, natural, economic, and social situations. Therefore, the ability to use mathematics in solving every day and abstract problems is one of the goals of mathematics education (National Curriculum Document, 2012).

The textbook (math) actually specifies the specific framework of the program at each grade, but it is not enough alone. Because this book is provided to the student, its appearance is important. Furthermore, the textbook should reflect the goals, methods, approaches and attitudes of the curriculum.

According to the document of the fundamental transformation of education, the main goals of mathematics education are:

1. Ability to apply mathematics to everyday problems
- 2- Emphasis on the culture and civilization of Iran and Islam and Iranian mathematicians and their role in the history of Iranian mathematics
3. Technology in mathematics and its applications

Canadian Education System

Canada is one of the seven industrialized countries in the world and has more than 7% of its gross national income allocated to education. This country has a great diversity in various aspects and this diversity has had a great impact on the education system of the country. Cultural and Information Tebyan Magazine, 2007. Quoted from David Robital)

The education system and its structure in different Canadian states are completely different from each other, but in general it can be said that the education system in Canada is consisted of a preschool period with a duration of 1 to 2 years, primary education with a duration of 5 to 8 years and Secondary education until the end of the 12th grade. (Office of Information and Opinion Survey, 2012)

Most math curricula in Canada are similar, and the new focus of math textbooks is on active learning and the math process. One of the reasons for the similarity of the books is that publishers include curricula

in their textbooks that are approved by at least two or more Canadian provinces to be more cost-effective. Math objectives is included in the curriculum guide published by each province. These objective are similar to the standard school math curricula developed by the National Council of Teachers of America and Canada (NCTM) (Vista Online Magazine, 2019).

Comparative Education

Comparative education is a knowledge that is being used in many countries (Farjad, 1994). According to Malinson, comparative education means regular study and analysis of other education cultures and systems in order to find similarities and differences and to find out that why different methods are provided to solve similar problems.

Comparative education is effective in improving the performance of education officials and helps to improve education systems.

One of the important findings of comparative studies in education is that education systems work in permanent and necessary relationship with other systems (culture, economy and politics), so, it is not possible to restrain schools to nurture students apart from society.

Knowledge of the changes and corrections in other countries education systems and their problems in revision and development of education and knowing the methods and plans that they had used to solve those problems could help us to indicate educational issues and apply correct approaches to solve them, especially when were want to establish a new educational system. Also, this can make it possible to think deeply about educational revisions and begin our movement towards public benefaction with measured and solid steps as a lawmaker, programmer and executor of educational programs and directors of education systems and don't gain same experiences gained by others by time and spending vast capital, just because of lack of knowledge.

The function of content analysis in relation to the textbook is affected by the characteristics of the textbook as an educational media, and due to the different characteristics of the educational media from other types of media, a different function of this method is expected in the educational media.

In this regard, with the method of content analysis, we can be aware of the social conditions and values at the time of producing textbook. Comparative study of textbooks of two countries or textbooks of one country in different time periods is possible in order to compare the prevailing social values at the time of textbook production using content analysis method. Therefore, textbook content analysis can be defined as: "The use of quantitative and qualitative, objective and systematic analytical methods to describe and be aware of its effectiveness in the teaching-learning process, overt and covert effects on learners and knowledge of social realities" (Nourian, 2015, pp. 113-111).

Research literature

In Iran, during the past years, when textbooks have always undergone revisions, the analysis of the content of these books has been considered by experts and researchers, but the comparative study of these books with textbooks of other countries has received less attention. This may be due to the unavailability to the textbooks in other countries. Ahmadi (2017) in analyzing the content of the tenth grade math book of 2017 stated that, this study was been done by content analysis method and the amount of use of various context-oriented issues in this book was been calculated.

Golposhnejad (2016) did the "comparative study of mathematics education in Iran and Australia (study of different mathematical topics in Shiraz and Brisbane) and stated that considering that the textbooks of these two countries are very similar to each other, but in the practice, this issue did not have a great impact on students' attitudes toward this subject in Iran, and changing attitudes toward mathematics and reconciling learners with it requires changing the attitudes of teachers and parents of students.

Akhtar and Saeed (2018) in the study "Mathematics Education: A Comparative Analysis of the Importance of Secondary Schools and the Importance of Education in Karachi" stated that the purpose of this study was to identify weaknesses and find information to raise the standards of mathematics education in Pakistan.

The subject of the study by Chang and Silalahi (2015) was "reviewing and analyzing the content of textbooks in educational research". In this study, researchers reviewed 44 published papers from 1953 to 2015 on math textbooks and concluded that most of them were about the analysis of standards and their proper classification, and the subject of some of them were numbers and operators and many of them were about elementary schools, and a few were analysis of math textbooks.

Research Methods

In this study, the content of the grade 10 math textbooks of Iran and Canada in the academic year 2018-19 was compared.

Population of the study: The study was a complete enumeration and parts of the two grade 10 mathematics textbooks in Iran and grade 10 mathematics textbook in applied sciences –mathematics in Iran with common topics were selected and thoroughly examined. Two chapters of these books taught the same material (trigonometry and function). The contents of these two chapters were coded according to the method of William Rumi.

Data collection tools and data collection methods

Analysis of the information of chapter text

First, the text of the two chapters of function and trigonometry from both grade 10 mathematics textbooks of Iran and Canada was coded by William Rumi method. In this research, the unit of recording was a sentence. Then the number of categories of each code was counted and categorized in tables.

Analysis of the exercises at the end of the chapter: Exercises at the end of the chapter in these two chapters were counted completely according to Bloom's cognitive level classification.

Data analysis method

Statistical method of textual information analysis of books

The text analysis of the book was done by William Rumi method as follows:

First, all the sentences of the book were coded according to the subjects used in it and as recommended by William Rumi;

Sentences of truth, code (a); Expression of results or general principles (b); Definitions (c); Questions answered (d); Sentences that are none of the above (e); Questions that lead learners to analyze (f); Sentences that require a particular activity from the student (g); Questions and exercises whose answers require testing and research (h); Sentences that make students look at pictures and instruct them to do something (i); Questions that do not have immediate answers. (j) The text engagement coefficient was calculated by the

$$\text{formula } I = \sum \frac{fghij}{abcde}$$

If the number obtained was between 0.4-1.5, the engagement coefficient was good and the presentation of the topics was active, but if the engagement coefficient was less than 0.4, the contents were inactive and the number higher than 1.5 indicated difficult text.

Statistical method of analyzing the exercises at the end of the chapter

To check the exercises at the end of the chapter, these exercises were first coded based on Bloom's cognitive levels as follows:

Exercises at the level of knowledge were identified with the number 1, exercises at the level of understanding with the number 2, level of application with the number 3, exercises at the level of analysis with the number 4, exercises at combination level with the number 5 and at the level of evaluation with the number 6. Then the number of exercises in each level was counted.

Results

Content analysis of the text of the book

Results obtained from the content analysis of the function chapter

Table 1: Results of the content coding of the function chapter

Engagement coefficient	j	i	h	g	f	e	d	c	b	a	
2.27	82	0	0	0	0	0	2	19	3	12	Iran
0.69	103	7	7	59	68	63	71	20	9	188	Canada

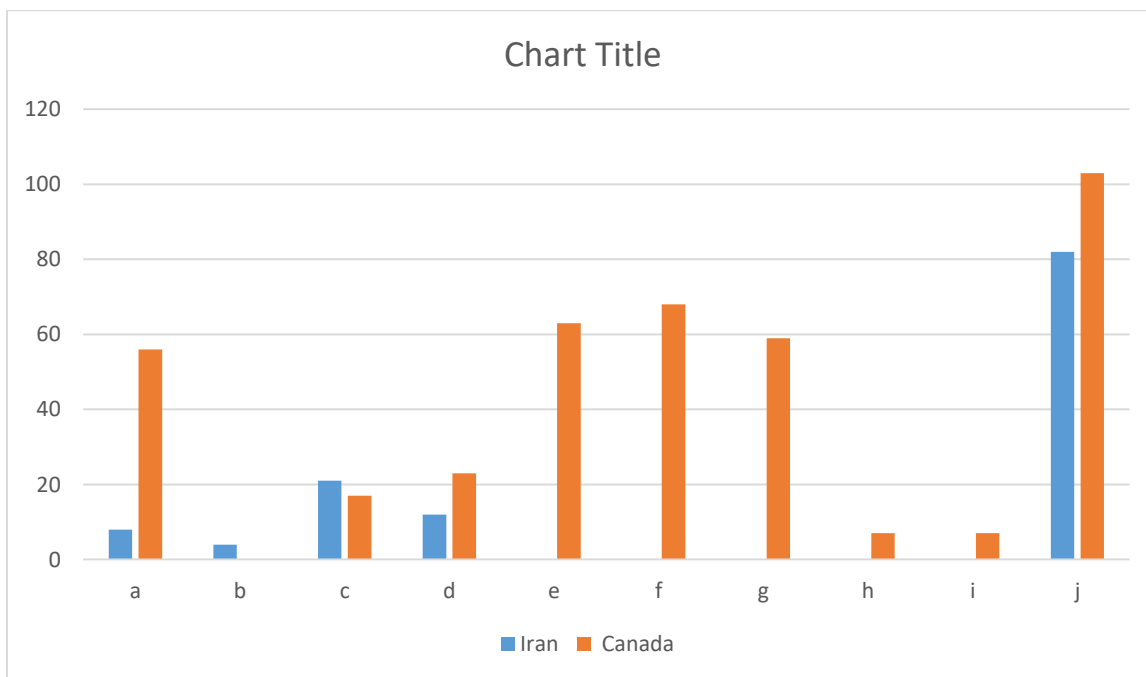


Figure 1: Comparison of the subjects used in the book chapters of Iran and Canada

Results from the content analysis of the trigonometry chapter

Table 2: Results of the content coding of the trigonometry chapter

Engagement Coefficient	j	i	h	g	f	e	d	c	b	a	
2.24	95	2	0	4	0	0	12	21	4	8	Iran
1.1	84	6	7	41	11	35	23	17	0	56	Canada

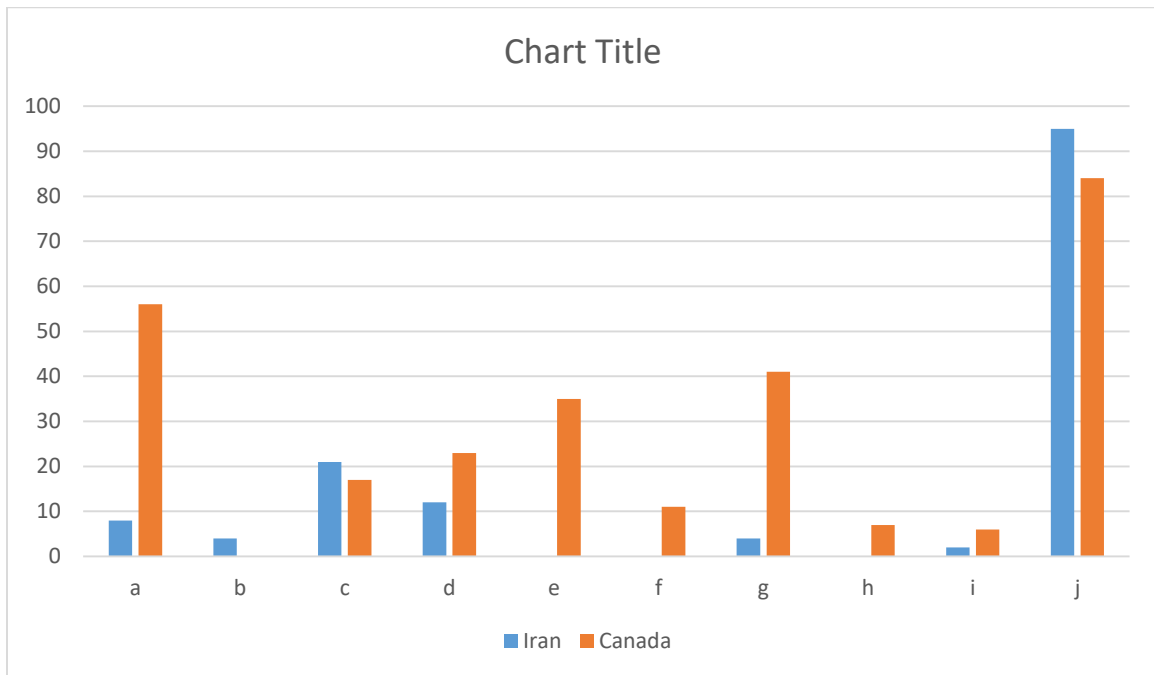


Figure 2: Comparison of the subjects used in the trigonometry chapter of two books, Iran and Canada

Results from the number of pages in these two chapters

Table 3- Number of pages used in the book

Total	Trigonometry	Function	
21	11	10	Iran
87	40	47	Canada

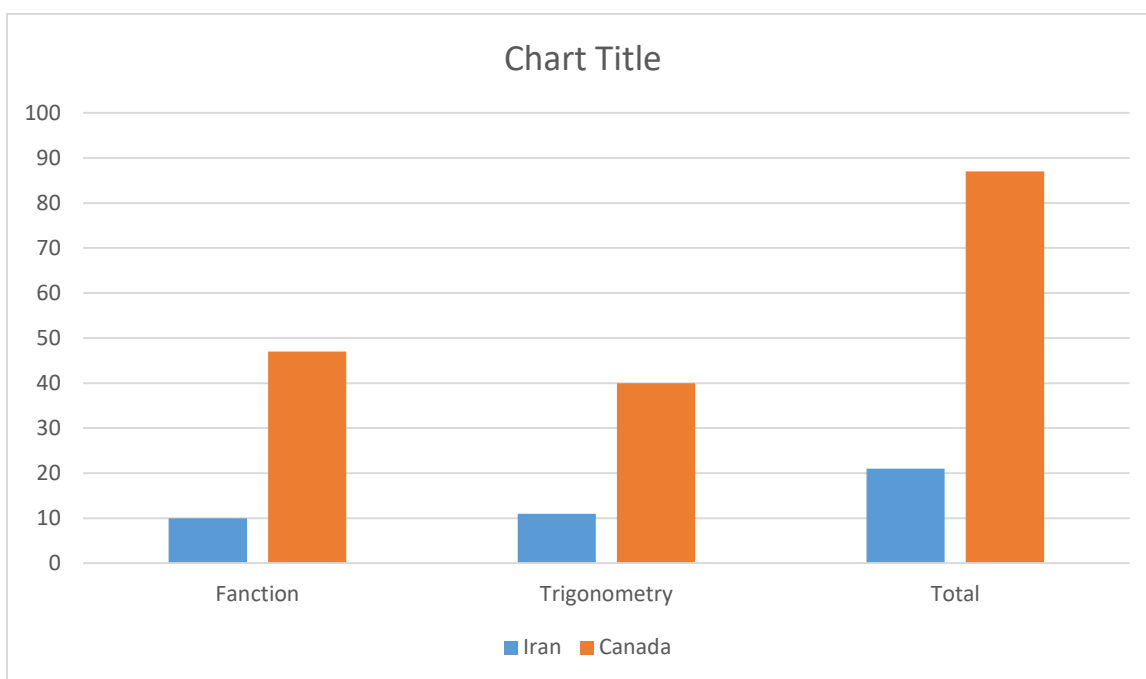


Figure 3: Number of pages used in the book

Content analysis of exercises at the end of the chapter

Table 4: Results of the exercises at the end of the function chapter

Evaluation	Combination	Analysis	Application	Comprehension	Knowledge	
0	0	0	3	52	0	Iran
0	8	37	71	137	0	Canada

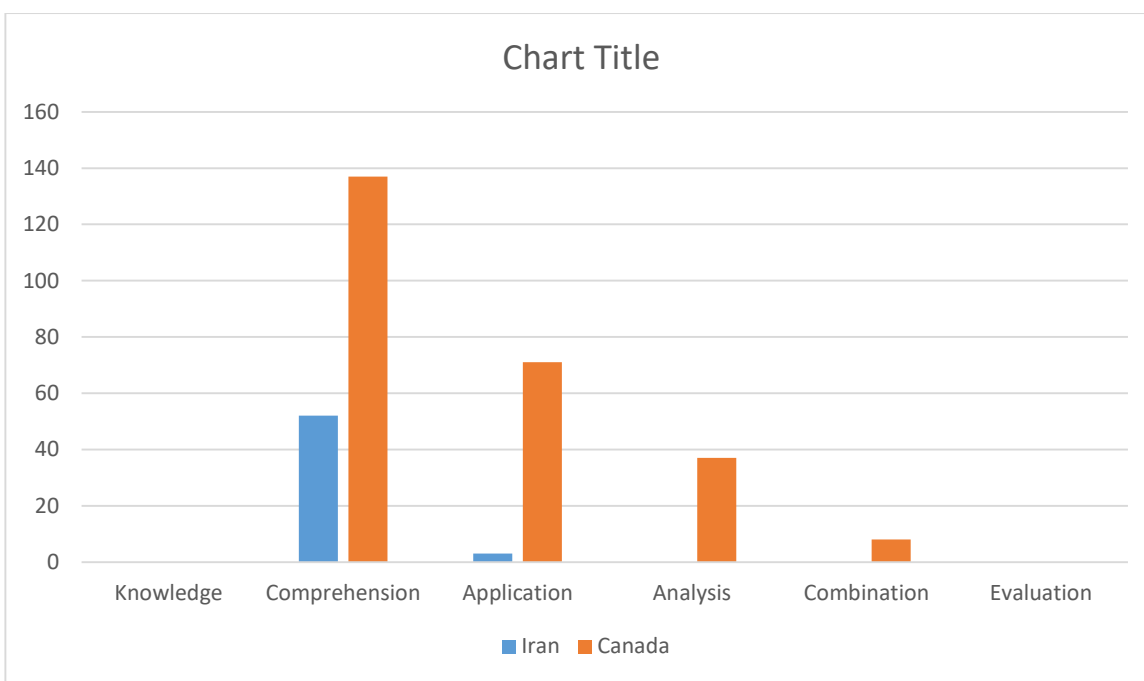


Figure 4: Comparison of the exercises in the function chapter of the two Iranian and Canadian books based on Bloom's cognitive levels

Table 5: Results of exercisers at the end of the trigonometry chapter

Evaluation	Combination	Analysis	Application	Comprehension	Knowledge	
0	0	2	7	7	0	Iran
0	5	31	86	134	0	Canada

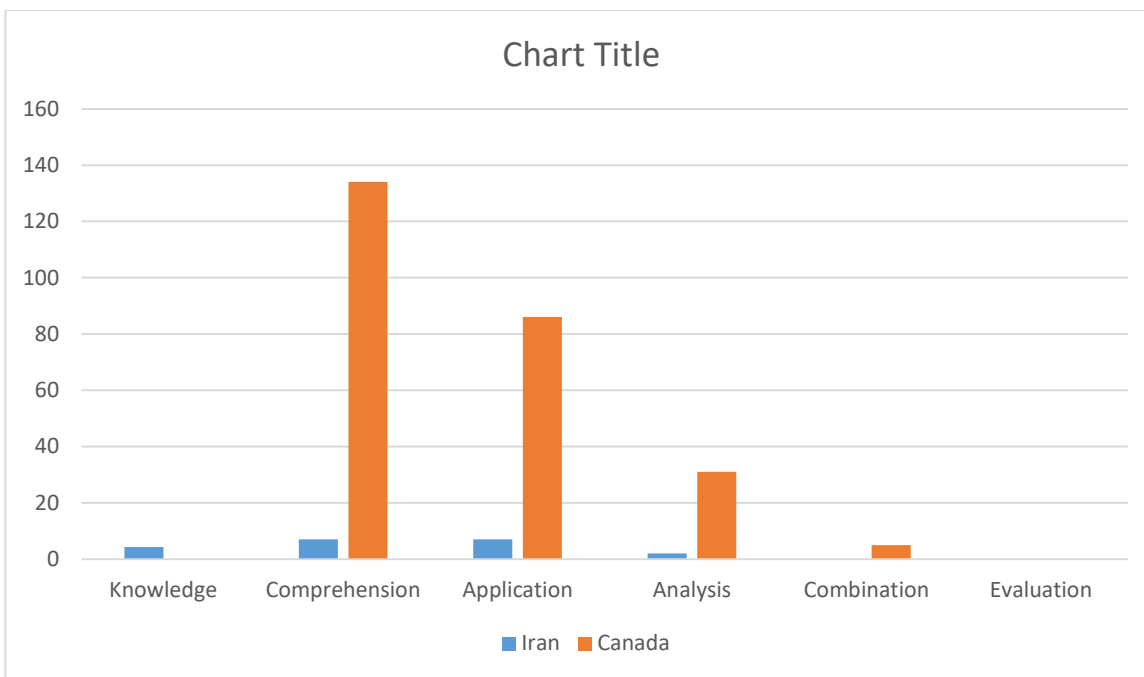


Figure 5: Comparison of Trigonometry Exercises in Iranian and Canadian Books Based on Bloom's Cognitive Levels

Table 6: Results of reviewing the number of exercises in the two books

Total	Trigonometry	Function	
71	16	55	Iran
509	256	253	Canada

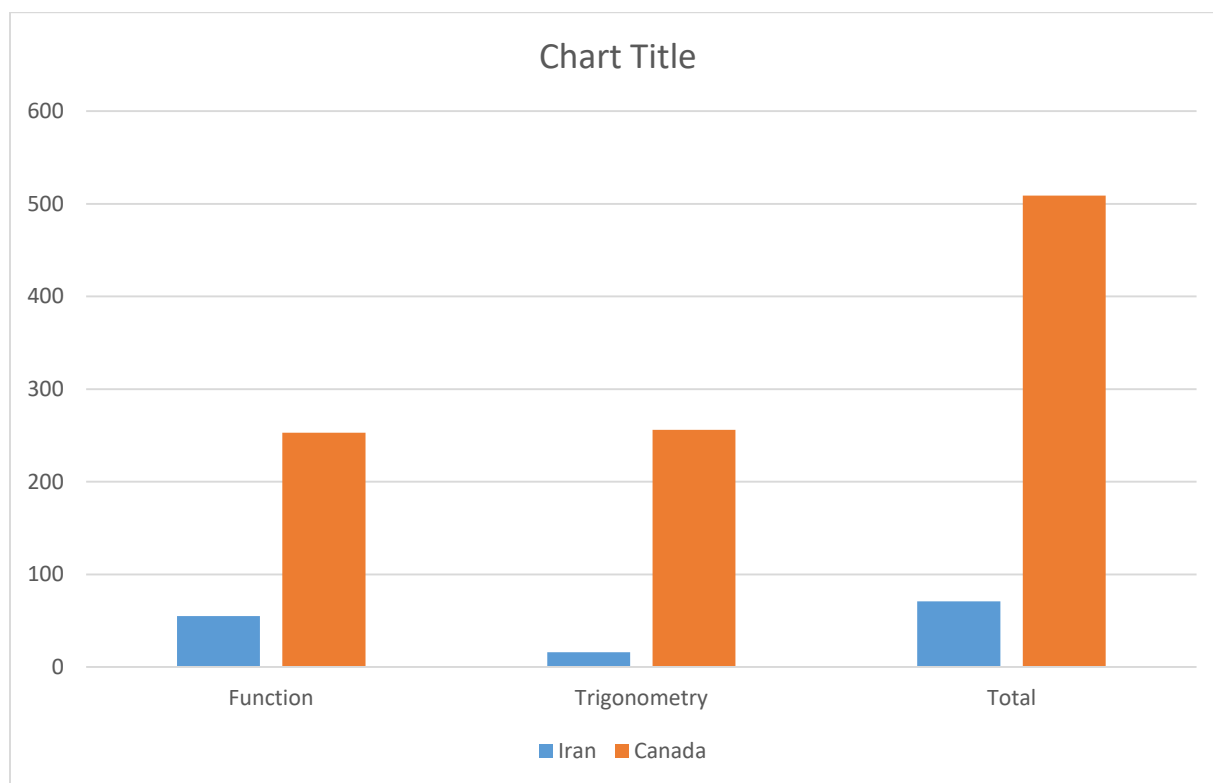


Figure 6: Comparison of the number of exercises in two books, Iran and Canada

Conclusion

This study aimed to analyze the quantitative content and compare the two grade 10 mathematics textbooks of Iran and Canada.

According to the data obtained from the study, it was observed that the text engagement coefficient in the function chapter of Iranian book was 2.27 and the text engagement coefficient in the function chapter

of Canadian book was 0.69 and according to what we know, if the number obtained from the calculation of the text engagement coefficient by the William Rumi method is between 0.4 to 1.5, the engagement coefficient is good and the presentation of the subjects is active, but if the engagement coefficient is less than 0.4, the material is inactive and a number higher than 1.5 indicates a difficult text. The text of the Canadian book with an engagement coefficient of between 0.4 and 1.5 had a good engagement coefficient and the subjects are actively presented.

The text engagement coefficient for the trigonometry chapter of grade 10 Iranian math book was 2.24 and the text engagement coefficient of the Canadian book trigonometry chapter was calculated to be 1.1. These numbers contain the fact that the text of the trigonometry chapter of grade 10 Iranian math textbook was difficult and the text of grade 10 Canadian math textbook in the trigonometry chapter was actively presented and had a good text engagement coefficient.

The grade 10 Iranian Mathematics Textbook devotes 10 pages of its contents to the discussion of introducing the function and its concepts, and the grade 10 Canadian Mathematics Textbook presents the same concepts in 47 pages. In the grade 10 Iranian Mathematics Textbook, a total of 108 subjects were presented in these pages, most of them are related to questions that are not answered immediately (up to 82), and in the grade 10 Canadian Math book, the same concepts were presented in 598 subjects, most of which stating a truth for the student (up to 188).

In the review of the exercises at the end of the two chapters in the Iranian and Canadian books, it was evident that the grade 10 Iranian mathematics textbook in the function chapter had a total of 55 exercises, 52 of which are at the level of comprehension and 3 of which were at the level of application. There were 253 exercises in the grade 10 Canadian math book in the function chapter, 137 of which were at the level of comprehension, 71 of which were at the level of application, 37 exercises were at the level of analysis, and 8 exercises were at the level of combination. None of the books had exercises at the lowest (knowledge) and the highest level (evaluation) of have Bloom's cognitive levels.

In the trigonometry chapter, presenting the same concepts, the Iranian book had 16 exercises, 7 of which were at the level of comprehension, 7 of which were at the level of application and 2 of the exercises were at the level of analysis. There were 256 exercises in the Canadian book, of which 134 exercises were at the level of comprehension, 86 exercises were at the level of application, 31 exercises were at the level of analysis and 5 exercises were at the level of combination, and like the function chapter in both books, there were no exercises at the levels of knowledge and evaluation.

According to the study findings, the text of the two function and trigonometry chapters in the grade 10 Iranian mathematics textbook was difficult (with a text engagement coefficient of about 2.25 for each), ie the student needed a relatively large amount of guidance from the teacher. But the grade 10 Canadian mathematics textbook was actively written in these two chapters (text engagement coefficient 0.69 for the function chapter and 1.1 for the trigonometry chapter) and the text of the textbook kept student active. Looking at the text of the Canadian book, it comes to mind that this book is written based on self-reading and the student can understand the concepts without the help of the teacher.

The same definitions and contents in the subject of function (19 definitions in the Iranian book and 20 definitions in the Canadian book) with a number of different items were presented in two books: In the grade 10 Iranian mathematics book, there were 12 sentences that presenting a truth versus 188 sentence in the Canadian book. The questions answered in the Iranian book in this chapter were 2 questions, while in the Canadian book in this chapter there were 71 questions with answers. The grade 10 Iranian mathematics book did not contain any questions that compel the student to analyze, while the grade 10 Canadian math textbook contained 71 questions that compel the student to analyze. Also, in the Iranian book, there was no sentence that required a special activity from the student, but in the grade 10 Canadian mathematics book, there were 59 sentences in the function chapter that required a special activity from the student. Finally, in the grade 10 Iranian mathematics book, there were 82 unanswered questions in the text of the function topic (0.75 portion of the text of the chapter) and in the same chapter of the Canadian mathematics book, there were 103 unanswered questions (0.17 portion of the chapter text).

In the trigonometry chapter, with almost the same definitions (21 definitions in Iranian book and 17 definitions in Canadian book), in the grade 10 Iranian mathematics textbook, there were 8 sentences stating

the truths, while in the Canadian book, there were 56 sentences stating the same concepts and introducing the student to the subject. The answered questions (solved example) in the Iranian mathematics textbook were 12 examples versus 23 examples in the Canadian book. In the trigonometry chapter of the Iranian book, there were no questions that compel the student to analyze, but in the Canadian book, there were 11 questions in this topic that compel the student to analyze. In the topic of trigonometry in the Iranian book, there were 4 sentences that required a special activity from the student, and in the same topic, there were 41 sentences in the grade 10 Canadian mathematics textbook that required a special activity from the student. So, Canadian grade 10 math textbook engaged students in comprehension and was activity-oriented. In the grade 10 Iranian mathematics textbook, in the trigonometry chapter, there were 95 unanswered questions (0.65 portion of the full text) and in the grade 10 Canadian mathematics textbook, there were 84 unanswered questions (30% portion of the full text). The unanswered questions in Iranian textbook is asked from student while giving the lesson, but most of the unanswered questions in the Canadian book are usually solved after an example and it is included like an unsolved example similar to the example in the book. "Example is more useful than the law! Nothing can be as useful as an example to clarify the subject of discussion," says George Polia in his book *Mathematical Creativity*. Regarding the unanswered questions in grade 10 Iranian textbook, it can be concluded that the Iranian textbook is written in the form of questions and answers between teacher and student and presents the subject in an exploratory way, which is a difficult and ambiguous method for students in mathematics.

In the reviewing of the number of pages presenting the material in each chapter in two books, these results were obtained: the function chapter of the grade 10 Iranian mathematics textbook consisted of 10 pages, while the grade 10 Canadian mathematics textbook had the same contents in 47 pages. In the trigonometry chapter, the Iranian textbook consisted of 11 pages versus 40 pages of the Canadian textbook. Considering the number of pages used in each chapter, it can be concluded that the Iranian book presented the content very quickly and fleetingly, but the Canadian book presented the content with more reflection and contemplation. Therefore, Iranian students should not be expected to learn the material deeply and completely.

In the exercises section at the end of the chapter, there were 55 exercises in the function chapter of the Iranian mathematics textbook, 52 of which were at the level of comprehension of the Bloom's cognitive levels, and 3 of which were at the application level. In the grade 10 Canadian Mathematics textbook, there were a total of 253 exercises in the function chapter, 137 of which were at the comprehension level, 71 were at the application level, 37 were at the analysis level and 8 were at the combination level.

In the trigonometry chapter of the grade 10 Iranian textbook, there were 16 exercises, of which 7 exercises were at the level of comprehension, 7 exercises were at the level of application, and 2 exercises were at the level of analysis of Bloom's cognitive levels. In the trigonometry chapter of Canadian textbook, there were 256 exercises, of which 134 were at the level of comprehension, 86 exercises were at the level of application, 31 exercises were at the level of combination and 5 exercises were at the level of combination. In other words, the grade 10 Canadian math textbook was richer in terms of the number of exercises than the grade 10 Iranian math textbook and included exercises in most of Bloom's cognitive levels. The presence of these exercises, especially the practical exercises involves student more with the subject and leads to deep and better understanding of the educational content.

The two chapters on function and trigonometry were presented difficulty in the grade 10 Iranian Mathematics Textbook, and this can tire the students' minds and cause them boredom and low self-esteem.

The two chapters on function and trigonometry are actively presented in Canadian grade 10 Mathematics textbook, and this will nurture dynamic and confident students.

In the exercises of the grade 10 Iranian mathematics textbook, most of Bloom's cognitive levels were absent, also the number of exercises was very low and this could lead to the confusion of students and make them to search for help books in bookstores.

Canadian grade 10 Mathematics textbook presented exercises for most of Bloom's cognitive levels, as well as their large number, and introduces students to a variety of questions.

Considering the review of these two chapters of the grade 10 math textbook of Iran and Canada, it can be concluded that the grade 10 Iranian math textbook has presented the materials very quickly and fleetingly, which makes the students forget the contents quickly.

Canadian grade 10 Mathematics textbook presented the same content with slowly and with numerous examples and that deepens students' learning.

Research Limitations

Lack of sufficient information and direct contact with Canadian teachers and students

Lack of adequate access to school-based teaching methods in Canada. Because education is not centralized in this country and is done in a special way in each state.

Suggestions and solutions

Evidences showed that mathematics teaching method affects students' beliefs in learning mathematics (Ranak, 2010, quoted by Mousavi, 2014) so that in case of poor teaching, it may affect some students not only in that course, but also make them to change their career path. (Mousavi, 2014).

The level of content of the two chapters of function and trigonometry, which were new and important topics in mathematics, was high in the Iranian grade 10 mathematics textbook compared to the learning power of learners, and the content of these chapters should be revised. This means that the learning should be easier by providing more information to them and solving various example problems.

Iranian math textbook exercises did not cover most of Bloom's cognitive levels. Other levels of students' cognition need to be measured by adding exercises at different levels of Bloom.

The number of exercises in Iranian mathematics textbook was very small. Students should be familiar with a variety of questions in the textbook. Adding more exercises can deepen students' learning.

Researchers are encouraged to compare mathematics textbooks of different courses and grades with other successful countries in education.

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