



A Comparative Study of Fifth Grade Mathematics Textbooks in Iranian and International Schools based on Critical Thinking Components

Morteza Samiee Zafarghandi¹ (Corresponding author)
Aboutaleb Seadatee Shamir²
Maryam Shamsolahi³

ARTICLE INFO	ABSTRACT
<p>Received: 05 January 2020 Revised: 27 February 2020 Accepted: 26 April 2020 Online: 01 May 2020</p>	<p>The main goal of present study is to compare content of Fifth Grade mathematics textbooks of Iran and International schools based on critical thinking components. The research method was a comparative using content analysis approach and statistical population and sample included all Fifth-grade mathematics textbooks of primary school of Iran and two International Schools in Tehran. To collect data, the content analysis form based on the components of Lipman's critical thinking was used. To determine formal and content validity, the researchers have used perspective of five experienced math teachers of primary schools and three university professors in the field of curriculum. The reliability coefficient of the research instrument was determined using Holste formula and it was for Iran and International schools equal to 0.89 and 0.84. Data analysis also showed that the content of Iran and International math textbooks are active up to 73% and 88% respectively. The research findings show that in mathematics textbook of Iran, components of critical thinking are unbalanced, which means that attention is more on necessary components of critical thinking such as questioning. However, the components related to analysis ability and high levels of critical thinking have received less attention. According to the findings of the research, the authors of the mathematics textbooks in Iran are suggested to improve content of math book, to provide a suitable ground for cultivating critical thinking of pupils.</p>
<p>KEYWORDS</p> <p>Content Analysis Critical Thinking Math Textbook International Schools Primary Schools</p>	

¹ Associate Professor of Organization for Educational Research and Planning (OERP), Tehran, Iran,
Email: mo_samie@yahoo.com

² Assistant Professor of Educational Psychology, Islamic Azad University, Science and Research Branch, Tehran, Iran

³ M.Sc. in Curriculum Planning, Islamic Azad University, Tehran, Iran

1. Introduction

Cultivating students' critical thinking is one of main goals of educational systems of the world, because education must create a spirit of criticism, curiosity, and research in learners. Today's schools, mainly in spite of advances in science and technology and psychological approaches, have paid more attention to transmission of information and have distanced themselves from educating thoughtful and creative people (Shabani, 2017). The results of various researches show that school textbooks in Iran do not provide a suitable ground for cultivating critical thinking in students. Farajzadeh (2014) in the study "Analysis of math textbooks' content based on Lipman's critical thinking" found that the level of attention to the components of critical thinking in First and Second Grades' textbooks of primary schools is low. Also, although the Third Grade mathematics textbook - compared to the first and second grades - has paid more attention to critical thinking components, the level of attention is still moderate. Hashemi (2006) in his study "Position of components of Matthew Lipman's critical thinking in the content of mathematics textbooks of middle schools" revealed that only 41% of total paragraphs of books allocated to critical thinking, although there is a capacity to make contents more critical and increase questioning and analysis components. Ekrami & Asareh (2015) in analyzing content of Farsi textbook of Sixth Grade of primary schools based on Lipman's critical thinking components indicated that highest and lowest percentage is related to questioning (20%) and explicit (6%) components respectively. The findings of Masudian, Davaee, Ansariyan, Khosravi (2018) also showed that the fitting of critical thinking training model - according to experts - was optimal led to a significant difference among experimental and control groups. In a study entitled "Poor situation of critical thinking in school Curriculum", Amini and Saboktakin (2017) found that because of various reasons, level of attention to critical thinking in school curricula and educational activities is low. Therefore, there is not much opportunity for students to develop their intellectual skills. According to findings of Sadati Pa'in Rood Poshati, Ebrahimzadeh and Ismailpour (2019), developing intellectual skills - especially critical thinking in learners - has always been a complex issue of educational systems and become critical today. In addition, education experts believe that in Iran, educational system and training methods are often memory-oriented with less emphasis on reasoning, understanding, analysis and thinking skills.

The results of the TIMSS and PIRLS Examinations – which are under auspices of International Association for the Evaluation of Educational Achievement (IEA) to discover and identify strengths

and weaknesses of educational systems around the world - also show that Iranian students did not perform well (Kabiri, 2014). The comparative findings of mathematics curriculum of Fourth Grade primary schools of Iran with leading countries in the TIMSS test also showed that attention to problem solving and analysis skills, applicability of topics, attention to attractive topics of algebra and statistics, as well as promotion of a positive attitude towards mathematics in Iran's curriculum has received less attention (Kiani, Danaei Yazarchi and Zavandarian, 2019).

This situation highlights need of attention to critical thinking because Iran's society needs more critical and creative people than ever before. For this reason and in current situation, critical thinking is one of most important issues in education (Zakeri, 2014). One of main goals of schools is to educate thoughtful and creative people and school curriculum should help learners to be able to reason, critique, analyze, and evaluate critical content and thinking. Various studies have highlighted relationship between critical thinking and problem solving, creative thinking, logical thinking, and metacognition (Karimian, 2018). According to the National Curriculum of Iran, critical thinking is one of the foundations of social and intellectual development of education (Nateghi, Yousefi, and Yarmohammadian, 2017). In this document, it is said about learning strategies that these strategies should provide ground for self-leadership, understanding goals, collaborative learning and self-efficacy and individual and group evaluation among learners. The formation of such thinking in children is not accidental and requires education and the creation of favorable conditions. In cultivating critical thinking, content and process should be considered together, and should not be limited to transfer of some information through textbooks or teacher only. Using a variety of resources can help foster students' critical thinking. Students' progress in educational system depends on use of critical thinking in various curricula. Countries that have realized the importance of issue of critical thinking have provided ground for its expansion with a comprehensive plan (Farajzadeh, 2014).

In addition to teaching resources, teaching method is also of particular importance. Active teaching methods such as exploration, problem solving, discussion, and modeling can be used to foster students' critical thinking. Also, type of evaluation and how it is implemented has an important effect on formation of critical thinking of learners, so that process-oriented methods help to create critical thinking and change better than response-oriented methods. The research results of Entazari and Farazandeh (2017) showed that teaching cognitive and metacognitive strategies - i.e. planning, control and monitoring strategies, self-regulation, and continuous monitoring - can

increase critical thinking. Achieving such skills requires that textbook content - including math - provide the necessary opportunity for students' practice. Given the breadth of critical thinking skills' concept and predictors, the question always arises as to what factors and activities underlie this thinking (Facione, 2011). Critical thinking - often in sources related to thought - is referred to as creative and logical thinking. So far, several definitions have been proposed for it. One of the most important and well-known definition is provided by Ennis (2010). He believes that critical thinking is thoughtful and logical thinking that focuses on making a decision or believing in something (Chan, Ho and Koo, 2011). The psychological perspective considers critical thinking skills as one of the cognitive and strategic skills that increase desirable outcomes. In other words, thinking is purposeful, reasoned, and involves solving problems, inferring, gathering information, and making decisions (Halpern, 2014). According to Stapleton, (2011), critical thinking is a thinking that explicitly intends to use appropriate assessment standards based on correct judgment to determine value, advantages, and benefits of a thing (Paul and Alder, 2006). John Dewey (2014) calls critical thinking as a reflection of thought and defines it as: active, continuous, and careful thinking about an idea or assumption derived from knowledge - in the light of the context in which it is supported and result provides. In general, thinkers agree on judgment, reasoning, metacognition, and thoughtful thinking which are key components of critical thinking (Chan, Ho, & Koo, 2011).

One of the thinkers concerned with education is Lipman, whose value system is based on school of pragmatism, especially John Dewey. Criticizing the traditional education system, Lipman seeks to restore and rehabilitate current educational system by presenting and implementing a philosophy program for children. So his grand goal, which is educating a generation of thinkers with critical and thought-provoking thinking, can be achieved. He emphasizes rational thinking and education - as intermediate goals of education - (Sadr, 2019). According to Lipman (2003), critical thinking has nine components: questioning (to create necessary context for identifying and expressing problem in student's mind), evaluating evidence and statements (evaluating evidence, terms, methods, and use valid methods), reasoning (presenting arguments with justification and difference between reason and justification and discernment of sophistry), being logical (attention to logical principles of examining things, organizing theories and concepts, preventing influence of logical errors, establishing logical communication between events , facts, concepts and general principles), interpretation (distinguishing between different meanings of a word, presenting various perspectives to solve problems and critique and study of different solutions), explicitness

(explicit and unambiguous expression of opinions and beliefs and acceptance of criticism of others), sociality (common research, commenting in public, listening and discussing with friends), correct judgment on issues (attention to use of criteria in judgments and study of philosophical dimensions of subject) , analysis and evaluation (finding similarities and differences, identifying key ideas, evaluating reasons).

Table 1.

Differences between normal and critical thinking from Lipman's perspective

Ordinary thinking	Critical Thinking
Guessing	Estimating
Preferring	Evaluating
Grouping	Classifying
Believing	Assuming
Inference	Logical Inference
Comprehensive concepts	Understood principles
Attention to communication	Attention to mutual relations
Imagining	Assuming
Suggestion without reason	Suggestion with reason
Uncritical judgment	Critical judgment

Lipman distinguishes between ordinary and critical thinking. In his view, ordinary thinking is simple and lacks criteria, but critical thinking is more complex and based on objective criteria. He urges teachers to make necessary changes to students' schedules (from normal thinking to critical thinking). According to Paul & Elder, (2006) the most important goal of mathematics education is to create ability of thinking and think correctly. This kind of thinking can almost be equated with problem solving. Resolving the inseparable part of mathematics and teaching it is a great opportunity to form mental and intellectual reserves in students and increase their understanding. Based on what has been said, the purpose of the present study is "To what extent critical attention has been paid to critical thinking in the fifth grade mathematics textbooks of the Iranian primary school compared to international school? Research questions include:

- 1- To what extent critical thinking components have been considered in mathematics textbooks (text, images, and activities) of Fifth Grade primary school of Iran and International School?
- 2- What are the similarities and differences between mathematics textbooks (text, images, and activities) of Fifth Grade primary school of Iran and International School regarding attention to critical thinking?

2. Research Method

The method of research is comparative using content analysis based on Matthew Lipman's critical thinking, which was implemented as follows:

- 1- The content of math textbooks in three parts of text, assignments and activities, and images were reviewed, coded and analyzed.
2. All units in all sections were matched with intended categories in terms of Matthew Lipman's critical thinking and recorded in the relevant tables.

The statistical population was math textbooks of Fifth Grade of primary schools of Iran and International Schools in the academic year of 2017-2018. It is worth mentioning that International Schools in Tehran has two active units for girls and boys separately. These two schools accept and register pupils who have previously studied abroad for some time. The math textbooks' feature is as follows:

- The mathematics textbook of Iran has 140 pages and 7 sections: Chapter 1: number writing and patterns, Chapter 2: deduction, Chapter 3: proportion and percentage, Chapter 4: symmetry and polygons, Chapter Fifth: decimal numbers, Chapter Six: measurement, Chapter Seven: probability. Each section begins with a picture board that includes general concepts of section.
- The mathematics textbook of International Schools is one of most popular textbooks introduced in Canada, and one of the US states. Scott Forsman is author of book and its seven sections is in accordance with Iranian book (numbers and patterns, deduction, ratio, proportion and percentage, symmetry and polygons, decimal numbers, measurement, probability). The total page of these sections was approximately 154.

In order to indicate formal validity, the opinions of 5 teachers and specialists of curriculum was used. To determine reliability, the Holistic reliability formula was used. For this purpose, 20% of each book was selected and one of the curriculum experts was asked to analyze textbooks content according to content analysis form. Using results of analysis of two categories of data, the agreement coefficient of the Iranian mathematical book was set at 0.89 and the International mathematical book at 0.84. To determine the data analysis, Shannon's entropy technique was used as follows.

- Determining frequency, amount of attention to critical thinking in content of books based on Lipman's critical thinking characteristics and level of active content of the book. It is worth noting that by definition, an active unit is one in which at least one component of critical thinking is considered.
- Determining coefficient of importance, using Shannon's entropy technique and normed data, the information load of categories was determined.

3. Results

The data in Table 2 show that most of content of both math textbooks is active, but share of active units in international schools is more than in Iran.

Table 2.

Review of book content in terms of activity and inactivity

Type/School	Iran*	International*
Active content	73	88
Inactive content	27	12

*= Numbers to percentages

Question 1: To what extent Iran's math textbook (text, images, and activities) has paid attention to critical thinking components?

Table 3 shows that out of a 552 units coded in Iranian math textbook related to components of critical thinking (text, images, and activities), the highest amount is about questioning skill with 289 cases (52.35) and the lowest to skill of being frank with 5 items (0.99). In addition, Figure 1 indicated that in math textbook of Iran, questioning skill has received most attention. Also, the highest coefficient of importance is assigned to questioning skill and lowest to analysis and evaluation skills. These results are consistent with findings of Farajzadeh (2014), Ekrami& Asareh (2015), Tarhami Ardakani (2011), and Hashemi (2006). All of this researchers has shown that in Iranian textbooks, the most attention has been paid to questioning skill compare to other critical thinking components - reasoning, correct judgment about ideas, etc. -.

Table 3.
Critical thinking components in mathematics textbook of Fifth Grade of Iran’s primary schools

Components	Frequency of components in lessons text	Activities and exercises	No. of Tables and pictures	Total frequency of components	Percent of frequency
Questioning skills	27	190	82	289	52.35
Evaluation skills of evidence and statements	4	17	6	27	4.89
Reasoning skills	5	16	1	22	3.98
Socializing Skills	2	6	0	8	1.44
Analysis and evaluation skills	7	41	5	53	9.60
Skill of being rational	5	48	7	60	10.86
Skill of being frank	1	3	1	5	0.09
Correct judgment skills on problems	1	8	3	12	2.17
Interpreting skills	6	58	3	67	12.13
Total	58	387	107	552	100

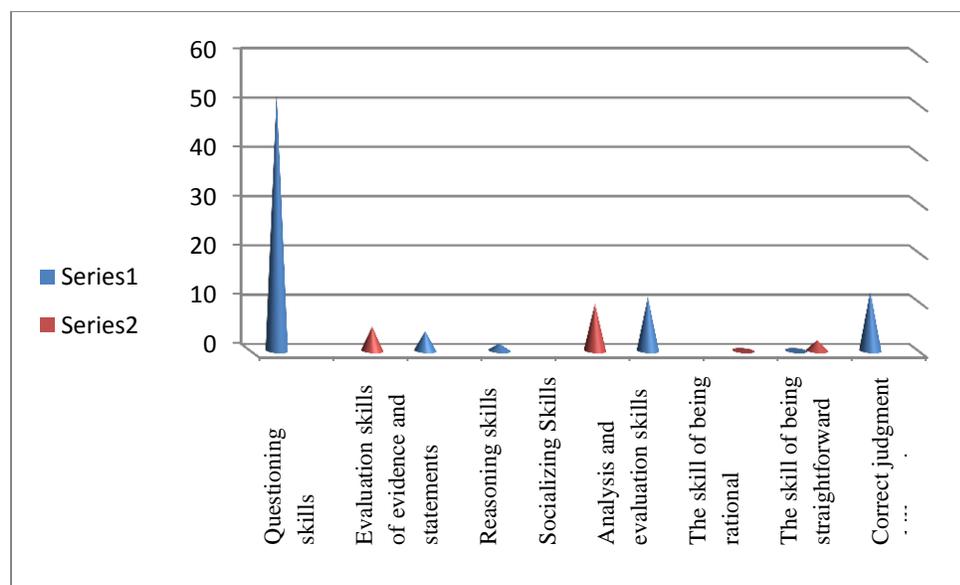


Figure 1.
Level of attention to critical thinking components in Iran

Table 4.

Data on normative components of critical thinking divided by chapters of math textbook (Iran)

Index/ Chapters	Questioning skills	Evaluation skills of evidence	Reasoning skills	Socializing Skills	Analysis and evaluation	skill of being rational	skill of being honest	Correct judgment skills on	Interpreting skills
1	59	6	2	-	13	8	-	2	17
	0.20	0.22	0.09	-	0.24	0.13	-	0.16	0.25
2	48	3	6	3	5	9	-	1	11
	0.16	0.11	0.27	0.37	0.09	0.15	-	0.08	0.16
3	86	5	3	2	6	5	1	-	6
	0.29	0.18	0.13	0.25	0.11	0.08	0.20	-	0.08
4	21	5	4	3	12	16	-	4	8
	0.07	0.18	0.18	0.37	0.22	0.26	-	0.33	0.11
5	18	2	3	3	9	12	2	-	9
	0.06	0.07	0.13	0.37	0.16	0.2	0.4	-	0.13
6	32	3	1	-	2	8	1	2	6
	0.11	0.11	0.04	-	0.03	0.13	0.2	0.16	0.08
7	25	3	3	-	4	2	1	3	10
	0.08	0.11	0.13	-	0.07	0.03	0.2	0.25	0.14
Total	289	27	29	8	53	60	5	12	67

Question 2: What are similarities and differences between Iran's fifth grade math textbooks and international schools in terms of attention to critical thinking?

Table 5 shows that number of active units in math textbook of International Schools is much higher than in Iran and several activities and exercises have been used to foster critical thinking. Out of 552 units coded in the Iranian math textbook, the highest frequency is related to questioning skill with 289 items (52.35) and the lowest amount is related to skill of to be honest with 5 items (0.09). Also, the highest coefficient of importance in critical thinking related to questioning skill (0.12) and lowest coefficient of importance are assigned to analysis and evaluation components (0.10). Out of a total of 1,056 units coded in math textbook of International Schools, the highest frequency is related to questioning skill with 171 cases (16/19) and lowest rate is related to social skill with 62 cases (5/87). Also in this book, highest coefficient of importance is related to interpretation (0.13) and lowest to the component of evaluation of evidence and statements (0.99). The results of this study are consistent with findings of Chien, & Hui, (2010), Masoudian, Dawai and Khosravi (2018) and Amini and Saboktakin (2017).

Table 5.

Comparison of attention to critical thinking the components in math textbooks of Fifth Grade in Iran and International Schools

Components	Iran			International Schools		
	Frequency	Percentage	Coefficient of importance	Frequency	Percentage	Coefficient of importance
Questioning skills	289	52.35	0.12	171	16.19	0.10
Evaluation skills of evidence and statements	27	4.89	0.11	112	10.60	0.09
Reasoning skills	22	3.98	0.11	167	15.81	0.12
Socializing Skills	8	1.44	0.11	62	5.87	0.10
Analysis and evaluation skills	53	9.60	0.10	160	15.15	0.10
Skill of being rational	60	10.86	0.11	110	10.41	0.11
Skill of being honest	5	0.09	0.11	71	6.72	0.12
Correct judgment skills on problems	12	2.17	0.11	117	11.07	0.11
Interpreting skills	67	12.13	0.11	86	8.14	0.13
Total	552	100	-	1056	100	-

4. Conclusion

The aim of present study was to determine level of attention to critical thinking components in math textbook of Iran's fifth grade primary schools and compare it with same book at International schools. Findings of various studies have focused on the impact of Lipman's theory and it was selected for content analysis of the mathematics textbook. The findings showed that most of the content of both math books are active, but the share of active units in the International Schools is higher than in Iran. In the book of Iranian mathematics, the components of critical thinking have been considered unbalanced, which means that more attention has been paid to questioning skill and less to analysis skill and high levels of critical thinking components. In Iran, the coefficient of

importance for questioning skill is 0.12 and for analysis and evaluation skills is 0.10, which is less than other components. In the mathematics of international schools, the components of critical thinking are almost balanced in comparison with Iran. The coefficient of importance of the component of interpretation is 0.13, which is more than other components, and the coefficient of importance of the component of evaluation of evidence and statements is 0.99, which is less than other components. Based on these findings, the content of the Iran book needs to be further examined, revised, and corrected to the components of critical thinking. To analyze and explain this issue, it is worth to mention that one of education's goals is strengthen power of reasoning, critical and creative thinking in students. Instead of transferring knowledge, schools should teach pupils how to learn. In Iran, based on the National Curriculum and the Document of Fundamental Transformation of Education, mathematics has been introduced as a part of daily life to solve problems.

Mathematics will train people who can reasonably reason and have the power to deconstruct and deal with problems. An important mathematical feature of human empowerment is to accurately describe complex situations, predict and control natural, economic, and social situations (Ministry of Education, 2012). The most important goal of math education is to create the ability to think and think correctly. Mathematics can be effective in fostering critical thinking when the text, content, and illustrations of the lesson, the teacher's teaching method, and the teacher himself are promoting critical thinking. According to Vygotsky's theory, critical education is possible through attention to role of knowledge along with role of teachers and learners (Masoudian, Dawai and Khosravi , 2018). One of the most important tools for creating critical thinking is questioning skill. Therefore, considering that the textbook is one of the most important references and resources for students' learning. It is suggested that by modifying and improving the content of textbooks - especially elementary mathematics textbooks - to provide a context for fostering critical thinking in students. Since this course is the most important course of study in all education systems in the world, teaching critical thinking in curricula of this age will make it popular in society. It is also suggested that a workshop on critical thinking methods be held for textbook authors and teachers.

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