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CULTURAL HISTORICAL ANALYSIS OF IRANIAN SCHOOL MATHEMATICS CURRICULUM: THE ROLE OF COMPUTATIONAL THINKING

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Abstract

In this paper, six mathematics curriculum changes in Iran will be reviewed, spanning from 1900 until the present time. At first, change forces, barriers, and the main features of each curriculum reform will be represented. The first five curriculum changes are described briefly and the sixth and most recent curriculum reform will be elaborated. In this paper, we call the last reform as contemporary school mathematics curriculum change. This recent (contemporary) curriculum reform will be explained in more detail, followed by a discussion of the effect of globalization and research finding in the field of mathematics and mathematics education (in the Iranian mathematics curriculum). In total, three key ideas are distinguished as an effect of globalization which is "New Math", "International Comparative Studies", and "Computational Thinking". Finally, the paper comments on the necessity of paying more attention to information and communication technology as part of globalization; in particular, recall policy-makers to consider "Computational Thinking" as an important component of future curriculum design.

Keywords: Computational Thinking, School Mathematics Curriculum, Globalization, Curriculum Change

Abstrak

Pada artikel ini, enam perubahan kurikulum matematika di Iran akan dibahas, mulai dari tahun 1900 hingga saat ini. Pada awalnya, kekuatan perubahan, hambatan, dan fitur utama dari setiap reformasi kurikulum akan terwakili. Pada lima perubahan kurikulum pertama dideskripsikan secara singkat dan reformasi kurikulum keenam dan yang terbaru akan diuraikan. Pada tulisan ini, kami menyebut reformasi kurikulum yang terakhir sebagai perubahan kurikulum matematika sekolah kontemporer. Reformasi kurikulum (kontemporer) yang terbaru ini akan dijelaskan secara lebih rinci, diikuti dengan diskusi tentang pengaruh globalisasi dan temuan penelitian di bidang matematika dan pendidikan matematika (dalam kurikulum matematika di Iran). Secara keseluruhan, tiga gagasan utama yang dibedakan sebagai efek globalisasi, diantaranya "Matematika Baru", "Studi Perbandingan Internasional", dan "Berfikir Komputasi". Terakhir, makalah ini mengomentari pentingnya memberikan perhatian lebih pada teknologi informasi dan komunikasi sebagai bagian dari globalisasi; khususnya, mengingatkan para pembuat kebijakan untuk mempertimbangkan "Berfikir Komputasi" sebagai komponen penting dalam desain kurikulum di masa depan.

Kata kunci: Berpikir Komputasi, Kurikulum Matematika Sekolah, Globalisasi, Perubahan Kurikulum

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Iran has a centralized educational system, so the mathematics curriculum and textbooks are designed at the national level and distributed around the country by the Ministry of Education and all schools, teachers, and students have to use the same mathematics textbook for teaching and learning of mathematics (Kiamanesh, 2005). Also, the main resource in all sorts of exams (like classroom assessment and national external exams) is the same math textbook which all students have access to. According to TIMSS math teachers' questionnaire, most Iranian math teachers in grades 4 and 8 reveal that they use mathematics textbooks as the main source for their teaching in classrooms (Mullis et al., 2008; 2012). So, in a centralized educational system, textbooks have an important role. The first Iranian National Curriculum was prepared and published by 2010 (Gooya, 2010). Therefore, in this paper through a *cultural historical review*, we will illustrate the Iranian mathematics curriculum reforms traced through Iranian mathematics textbook changes. Indeed, mathematics textbook changes show the reflection of new aims, scopes, and direction of the mathematics curriculum.

Iranian mathematics curriculum has experienced six reforms from 1900 until now which five of them occurred before launching the National Curriculum in Iran and one of them occurred subsequently and upon the direction of the National Curriculum (Rafiepour, 2018). Indeed, the Iranian national curriculum was prepared and announced by the Ministry of Education in 2010 (Gooya, 2010). After launching the Iranian national curriculum, recent reforms in all mathematics textbooks began, and gradually all of the math textbooks at primary and secondary levels changed upon new direction. In this paper, the recent reform (post-2009) will be known as contemporary mathematics curriculum reform.

Despite the main focus of this paper being an analysis of the contemporary reform in the Iranian mathematics curriculum, using an application and modeling point of view, past reforms dating from 1900 to 2009 shall also be reviewed. This will allow a better understanding and a more comprehensive picture to be gleaned of historic Iranian mathematics curriculum reform. Therefore, in this study, we will explore the following research questions through cultural historical perspective, as follow:

1. What were the key ideas which guided the changes in school mathematics over time?
2. What are the main ideas for future change?

In this paper, Computational Thinking will be introduced as an effect of globalization which will be considered for future educational changes. We have to distinguish between internationalization as cultural imperialism and globalization as global collaboration for sustainable development. This paper discusses curriculum changes in the Iranian context, but there are at least two international contributions which would inform scholars from different contexts and courtiers around the world. Firstly, the Iranian context as a developing country was analyzed so the ideas which are discussed can help other scholars from developing countries learn how they can integrate them globalization effect into their official curriculum. Secondly, discussion about how the Iranian school mathematics curriculum provides an in-depth insight into mathematical content and process in which Iranian migrant students learned during their study in Iran (Farsani, 2015; 2016). At this time there are 7 million Iranian migrants which live abroad where the majority (around 1.4 million) live in the USA. The findings of this retrospective cultural historical review can therefore help mathematics teachers and curriculum developers in developing countries for devising better programs for migrant students.

METHOD

In this paper, we use a cultural historical approach for analysing mathematics curriculum change in Iran from 1850 until now (170 years). For this purpose, we collected all kinds of materials (e.g.

academic articles, books, and reports) which refer to Iranian mathematics curriculum changes, and reforms during this period of time, both English and Persian. In order to address our first research question, we reviewed and thematically analyzed all materials (papers, books, reports, and mathematics textbooks) to determine the main features of each mathematics curriculum reform in Iran. Subsequently, then we extracted the key ideas which guided the changes in school mathematics over time. For pursuing our second research question, we reviewed official documents of developing countries (e.g., USA, UK, Canada, Japan, etc.) for presenting main ideas in future mathematics curriculum reforms.

RESULTS AND DISCUSSION

In this section all, educational changes and mathematics curriculum reforms from 1900-2009 will be briefly reviewed and change forces and barriers of past reforms will be discussed. Some of these reforms were previously distinguished and explained in national journals and magazines by other Iranian scholars in Persian (Farsi) language which is the official language in Iran (e.g. Jalili, 2016; Rezaie, 2016).

The first mathematics curriculum reform started after establishing a new type of school in Iran to look like a European school style. In 1851, the first Iranian school (namely 'Dar Ul-Funun') was established in Tehran (Capital city of Iran from 1788). The key ideas of the mathematics curriculum in the first curriculum reform were preparing students for solving real world problems. So, mathematical concepts taught through practical application and joined with other discipline such as geography. In first Iranian school, foreign teachers were employed to teach modern knowledge to Iranian students. Gradually, this school published some textbooks on a different subject. These textbooks continued to be used until 1938 where the Ministry of Education tried to unify them (include mathematics textbooks) by 1938. So, the second mathematics curriculum reform starts from 1938 and continues until 1962, during which time all mathematics textbooks orchestrated solidarity all over the country. The key framework of mathematics curriculum in the second curriculum reform was designing core mathematics ideas for all students in the country. In this reform content of mathematics contain geometry, algebra, and arithmetic (Rezaie, 2016).

In 1962, the third reform in the mathematics curriculum started after the White Revolution (Revolution of Shah and Peoples). This curriculum changes as third reform stimulated with educational system changes by 1967 and the educational system was divided into three sections: Primary school (5 years), Intermediate or guidance school (3 years), and Secondary school (4 years). All textbooks include mathematics textbooks changed during this reform (Rostami, 1978; Orton, 1981). According to Orton (1981) the key ideas of the third curriculum reform were related to educational system changes and mathematics textbooks designed and published by an organization which works under ministry of education.

The fourth reform starts in 1975 and continued until 1992. In this time "New Math" was introduced to the Iranian school mathematics curriculum. Traces of "New Math" could be seen all over the mathematics textbooks during this period from primary to secondary level. At that time, students were divided into two types of school (theoretical and vocation) after grade 8. In theoretical school, students have divided again into three different groups: Mathematics and Physics, Experimental Sciences, and Human Sciences. The key ideas of mathematics curriculum in the fourth curriculum reform were adding some component of "New Math" into the math textbooks specially for students studying Natural Sciences, such as Mathematics, Physics, and the Experimental Science branches. As a result of integrating "New Math" into the math textbooks, mathematics became meaningless for students. So, only small numbers of students (about nine percent) chose math and physics for their future studies (Rejali & Parvaneh, 2019). Therefore, there would be a future shortage of candidates in math and science-related roles. As a reaction to this social phenomenon, the High Commission of Fundamental Changes in Educational System decided to launch new reform.

The fifth reform started from 1992 until 2009, as a reaction to new math and this curriculum reform influenced just secondary level (grade 9-12) and this reform coincided with educational system changes (Gooya, 2007). The educational system is divided into four sections: Primary (5 years), Intermediate (3 years), Secondary (3 years), and Pre-University (1 year). Another change in this reform; the school year starts from September to June, which is divided into two parts (as a semester) instead of three parts (as before). There is special attention to vocational education at the secondary level during this reform. In this reform, all mathematics textbooks in grades 9-12 were changed. During this reform research finding in the mathematics education domain was used widely and in some of the mathematics textbooks at the time, there are some features of constructivism point of view and problem-solving activities which would draw upon new findings in the field of mathematics education (Gooya, 2007). Mathematics changes also considered, titled "discrete mathematics", was added to grade 12 as a separate mathematics textbook for students in the mathematics and physics branch.

Contemporary Mathematics Curriculum Changes

The Iran National Curriculum project started in 2006 in the High Commission of Fundamental Changes in Educational System (under High Commission of Cultural Revolution) and the first edition of this document was published in 2009. After approval of this national curriculum in 2010, the sixth and most recent mathematics curriculum reform started and continues until now. In this Office for Developing National Curriculum (2010) there are eleven learning domains which Iranian students have to study during their formal education. Mathematics is one of these learning domains which is defined as a science of pattern, asymmetry, art, and finally precise language. In the Iranian national curriculum document, several roles for the necessity and function of mathematics are considered, as follow:

1. Understanding the laws of nature (anticipating and controlling different natural situation)
2. Solving real-world problems
3. Developing a method of thinking in other natural and human science enhances rational reasoning.

There are four content topics (Number and Operation, Algebra and Symbolic Representation, Geometry and Measurement, Data and Statistics and Probability), and seven process topics (Problem Solving, Modelling Real Data, Reasoning, Visual Thinking, Creative Thinking, Connection, Communication) in the Iranian national curriculum document.

In this document, there is an emphasis to express the role of Iranian mathematicians in developing mathematics in the Golden Islamic Age (Europe’s Dark Ages). In some of the mathematics textbooks which were published after the approval of the Iran national curriculum, there are substantial historical references to the works of Iranian mathematician and scientists in the Golden Islamic Age which have a major impact on Muslim culture and civilization. In Iran's national curriculum, there is also an emphasis on the use of technology (such as calculators and computers) in mathematics. Not, however, seen in new mathematics textbooks!

After the enactment of the Iranian National Curriculum, contemporary mathematics curriculum reform started in Iran and two mathematics textbooks (one from the primary level and another from secondary level) were changed in each school year. Now, almost all school textbooks were changed or modified upon the national curriculum.

The sixth curriculum reform is also stimulated with educational system changes. The educational system is divided into four sections: Junior Primary (3 years), Senior Primary (3 years), Junior Secondary (3 years), and Senior Secondary (3 years).

More Details of Contemporary Mathematics Curriculum Changes

It seems that new contemporary mathematics curriculum changes have small influences on the process of teaching and learning mathematics in Iran. Several studies show that there is still plenty of work to do. As an example, TIMSS 2015 reveals that Iranian students’ performance in mathematics in both grades 4 and 8 increased, but this result shows that Iranian students’ performance is still below the international average and still not good (Mullis et al, 2016). There is a public opinion among Iranian people about Iranian students’ performance in mathematics. Most Iranians think Iranian students had or must have good performance in mathematics because of their good record in the mathematics Olympiad contest where they have finished in the top 10. However, when the first results of TIMSS were published around 2000, Iranians were shocked and after that, the poor performance of Iranian students became one of the researchers' and policy-makers’ main concerns.

After analysis of some new mathematics textbooks published during recent, contemporary curriculum reforms, Gholam-Azad (2015) mentioned some of the challenges of new textbooks. It could be observed upon that the importance of these challenges is an instrumental understanding of recent research findings, instead of a rational and deep understanding of them. Gholam-Azad (2015) said instrumental (superficial) understanding of recent research findings cause to reverse outcome. To clarify superficial understanding of research findings, we will focus on application and modeling (which is one of the mathematics processes in the Iranian National Curriculum). This will allow for a discussion through the systematic literature review of research studies related to mathematics textbooks.

The modeling approach means a process that starts with a problem situated in the real world. The modeling process continues with formulating real-world problems in mathematical terms. When this process is complete, the mathematical problem can be solved by the application of mathematical concepts and solution processes. Finally, the mathematical solution must be interpreted to provide an answer to the real-world problem and checked for its adequacy in answering the original question. A new cycle of the formulation may then begin for improving the model. In Figure 1, a simple diagram of the modeling cycle is presented.

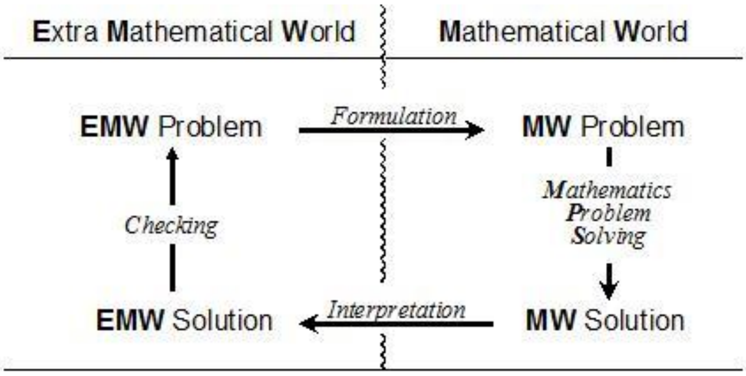

Figure 1. A model of the modeling cycle (Verschaffel, 2002)

In all of the new mathematics textbooks which were written after a re-enactment of the national curriculum, authors of textbooks mentioned their loyalty to the national curriculum in the preface of each textbook. So, there are some parts in these mathematics textbooks related to the application of mathematics in the real world, but almost all of them are of superficial usage of mathematics in the real world, and not real modeling. An example of modelling problem from literature review mentioned in Figure 2.

How can different rates of various mobile phone contracts be compared depending on customers' habits?

Figure 2. An example for modelling problem (Kaiser & MaaB, 2007)

A study of Rafiepour, Stacey & Gooya (2012) shows that modeling activities are absent in the new mathematics textbook in grade 9, while there are some standard application tasks included. Several research studies show that in new Iranian mathematics textbooks series, at the primary and secondary level, there isn't actual modeling activity (e.g. Rafiepour, 2012; 2014; Khani & Rafiepour, 2015).

The contemporary mathematics curriculum integrates different modalities for meaning-making such as the use of technology, diagrammatic representations, and symbolic notations. These modalities are perceived to be rich resources in mathematical contexts particularly when the medium of instruction may not be the learners' native tongue (Farsani et al., 2020; Rosa et al., 2020). By integrating these visual modalities in the curriculum would empower students who are not communicative competent in the language to be more engaged with the mathematical content (Krause & Farsani, In Press). Therefore, the phase transitions of this contemporary curriculum can enable mathematics teachers and curriculum developers in developing countries for devising better programs for migrant students.

Impact of Globalization in School Mathematics Curriculum

Several curriculum changes can be distinguished as an effect of globalization in Iranian mathematics curriculum history. In this section, these curriculum changes will be reviewed through historical order. The Office for Developing National Curriculum (2010), explicitly does not mention globalization and its position in the national curriculum, with just a definition of globalization expressed in the appendix of the national curriculum document. However, investigation of Iranian mathematics textbooks shows that recent research findings in the fields of mathematics and mathematics education were to be used for shaping new changes in math textbooks during that time. For example, during 'Dar Ul-Funun' time (1851-1938), European teachers jointly with Iranian partners, try to develop new textbooks for updating Iranian students with new knowledge. As another example, during the fourth reform (1975-1992), "New Math" was introduced to the Iranian school mathematics curriculum. In more recent reforms in the Iranian mathematics school curriculum, writers of textbooks try to use the recent findings of mathematics education. For example, in the fifth Iranian mathematics textbooks reform (1992-2009), there is an emphasis on constructivism and problem-solving in some of the mathematics textbooks. In contemporary and sixth Iranian mathematics textbooks reforms, writers continue to emphasize problem-solving skills and cover some application of math through the math textbooks in all grades.

Another context for the effect of international experiences on changing the Iranian mathematics curriculum related to Trend International Mathematics and Science Study (TIMSS) data will follow. Iranian students participated in the TIMSS study from 1995 until the present day, in different grades. Iranian students' performance in mathematics was not good and in all TIMSS studies (1995, 1999, 2003, 2007, 2011, and 2015) was below the international average (TIMSS, 2016). Although in grade 4, Iranian students' performance increased from 387 in TIMSS 1995 to 431 in TIMSS 2015, and in grade 8, Iranian students' performance increased from 418 in TIMSS 1995 to 436 in TIMSS 2015; but this situation is still not perceived to be desirable. Educational policy-makers frequently ask researchers and curriculum developers to reform the Iranian school mathematics curriculum toward enhancing Iranian students' performance in the TIMSS study. In contemporary school mathematics textbooks reform, writers try to direct change in such a way to focus on problem-solving in all mathematics textbooks and to respond to educational policy-makers' concerns concerning Iranian students' performance in TIMSS.

Results of another large-scale international assessment, namely the Programme for International Students Assessment (PISA) which is organized by OECD, influence the mathematics curriculum in many countries (de Lange, 2021). The Iranian mathematics curriculum was not an exception. Although Iran didn't participate in PISA until now, PISA has had an implicit effect on Iranian school mathematics (Stacey et al., 2015). PISA was introduced to the Iranian community through mathematics educators' research, at first. Following this, several teachers of mathematics who had started their master's degree researched mathematical modeling and applications, which is one of the focal points of PISA. The results of this research were published in national and international conferences and journals. Through this sharing, other mathematics teachers familiar with PISA can benefit and improve their practice of teaching and learning mathematics in Iran. Aforementioned, there is some sort of application of mathematics in all-new versions of mathematics textbooks to reflect the passion of the community.

Finally, the last and recent globalization effect in many curricula changes around the world related to Computational Thinking (CT). Indeed, human beings in society have become more and more technology-based in the 21st century and must have appropriated knowledge to perform their work in a more efficient manner, in which such a society is heavily integrated with technology (Bocconi et al., 2016). One of the important aspects that everyone has to know is CT as Wing (2006) suggested, "to reading, writing, and arithmetic, we should add CT to every child's analytical ability" (p. 33). Shodiev (2014) defines CT as a way of thinking algorithmically using design trees from computer science as a guiding structural, and sometimes metaphorical, framework. Wing (2014) also defines CT as "the thought processes involved in formulating a problem and expressing its solution(s) in such a way that a computer-human or machine—can effectively carry out" (para. 5). Hoyles and Noss (2015) consider CT as abstraction, algorithmic thinking, decomposition, and pattern recognition. CT involves concepts (e.g. loops, conditions) and practices (e.g., abstraction and debugging) (Lye & Koh, 2014; Kafai & Burke, 2013). However, CT is not simply programming and rote skill, but it is a conceptualizing and fundamental skill; a way that humans think (Wing, 2006).

CT changes the nature of some contemporary researches in the mathematics domain. For example, we can see the computer-based proof in mathematics (e.g. four-color theorems). For another example, a new domain of research related to mathematics and computation such as Bioinformatics emerged recently. In this regard, the European Mathematical Society (2011) recognized an emerging way of engaging in mathematical research: "Together with theory and experimentation, the third pillar of scientific inquiry of complex systems has emerged in the form of a combination of modeling, simulation, optimization, and visualization" (p. 2). Weintrop et al. (2016) try to address CT as a more sophisticated concept upon literature review and interview experts who use CT in their carrier. They develop a taxonomy of CT skills which has close relation with the third pillar of scientific inquiry. This taxonomy contains four main categories: data practices, modeling and simulation practices, computational problem-solving practices, and systems thinking practices. In each category, Weintrop et al. (2016), explain what sort of activities are used by mathematicians and scientists related to CT, and based on this they "provide a roadmap for what CT instruction should include in the classroom" (p. 128).

This effort for combining CT in mathematics education is not new and investigation on the historical origin of CT in mathematics education shows a legacy of over 53 years in which begins by designing LOGO programming language in the theory of constructionism (Papert & Harel, 1991). Studies of constructionism at higher-level mathematics education show how programming supports students' understanding of mathematical concepts (e.g., Leron & Dubinsky, 1995; Wilensky, 1995) and how it contributes to the development of critical thinking skills (e.g., Abrahamson et al., 2006; Marshall, 2012). Kaufmann and Stenseth (2020) demonstrate in a case study, lower secondary school-level pupils use programming to solve a mathematical problem.

CT activities can enhance the learning of difficult mathematical concepts through low floor high ceiling (Gadanidis et al., 2017). Weintrop et al. (2016) explain the mutual relationship between CT and mathematics education in which CT activities can deepen the learning of math and vice versa, with mathematics providing a meaningful context for CT. In Buteau et al. (2020) paper, the concept of "legitimate peripheral participation" was used, which is defined by Lave and Wenger (1991) for describing how learners enter into a community and gradually take up its practices. In this paper, legitimate peripheral participation was used to understand how undergraduate students learn mathematics through CT activities. Through these activities, students encounter mathematical ideas and problems; they then try to use CT as a means for constructing an "object to think with". This is in line with Papert (1980), who believes the computer provides the learner a means for constructing "objects to think with" (p.204). Indeed, this view on learning concords with the constructionism paradigm.

At this time, there is nothing about computational thinking (CT) in Iran's National Curriculum and school mathematics textbooks. However, there is a chapter (10 pages long) about building a computer game using Scratch software in the grade nine "work and technology" textbook (Esmaili et al., 2020). This chapter starts with a discussion about the advantages and limitations of computer games and then expresses the disadvantages of using a computer game. The chapter continues with introducing Scratch software components, how to change the language of the program, and so on. Then devises a simple project for drawing a rectangle through the representation of the Scratch software cat. It finally asks students to complete a real project related to design the "balls and rocket" game (see Figure 3).

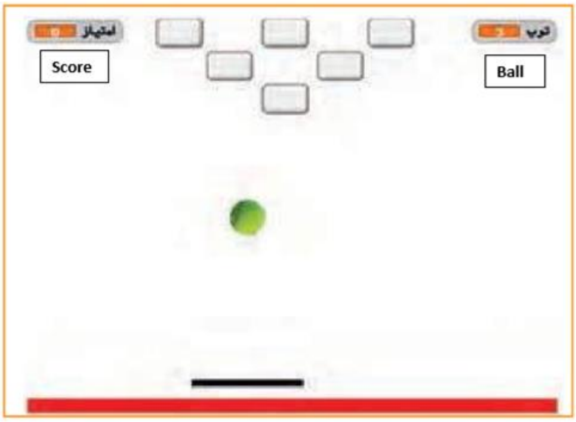

Figure 3. “balls and rocket” game page 48 of grade nine “work and technology” textbook

In this final project, students will become familiar with the concept of variables (in terms of computer science which is a place for saving dynamic information) and roles of that in programming and they start to have experience with writing scenarios for designing a game. In the 10-page unit in the grade 9 “work and technology” textbook, there is a short comment about debugging a computer program. Besides, there is an after-school program in which students in some provinces participate in and learn computational thinking skills.

CONCLUSION

A review of mathematics curriculum reforms in Iran shows that every 15-20 years, Iranian mathematics textbooks were changed. In all of these reforms, some barriers hinder progression. It seems one of the important barriers is related to the teacher education program. For example, Gooya's (2007) research shows that traditional mathematics teachers didn’t believe in the constructivist point of view and they are opposed to geometry curriculum change in direction to constructivism. Several researches show that teachers of mathematics haven’t adequate knowledge for implementing contemporary curriculum change which related to modelling and application (Rafiepour, 2014). Indeed, teachers of mathematics hadn’t access to good resources to improve their knowledge and skills in line with the direction of new educational reforms regard to modelling and application (Rafiepour & Molaie, 2020). They didn’t receive suitable content and pedagogical knowledge during their pre-service and in-service program concerning modelling and application (Rafiepour, 2016). In such a situation, teachers stand alone with their problems and they didn’t receive suitable and adequate support. It is more and more important to support math teachers for future mathematics curriculum reform, especially in the 21st century where changes occur quickly, and the school mathematics curriculum must reflect these new changes in new reforms. Teachers are the most important and smallest loop in the curriculum chain. If teachers are properly supported through pre-service and in-service programs, then we can expect improved results after any educational reform.

A review of the history of education reforms in Iran reveals that there were several different reasons for different educational changes such as:

1. Varying goals, perspectives, and educational expectations upon social changes
2. Assessment of implemented curriculum
3. New research finding in the field of mathematics and mathematics education
4. Widespread usage and pervasiveness of technology such as a computer, Internet, smart boards, calculators, and so on.

This latter reason is the contemporary concern of almost all educational systems around the world and one that has been neglected. It should be given more attention in the Iranian educational system. Society has become more and more technology-based in the 21st century and must have the appropriate knowledge to perform their work in a more efficient manner, in which such a society is heavily integrated with technology. Gardner (2006) mentioned the future world with a search engine, robots, and other computer-based instruments will demand capacities that until now have been mere options. To meet the new world demand capacity, one of the necessary skills that every student should learn is CT, which Wing (2006) suggested "to reading, writing, and arithmetic, we should add CT to every child's analytical ability" (p. 33). CT will change the paradigm of many businesses in the future and change the job environment.

Today, many countries around the world address computational thinking (CT) in their school curriculum as part of the mathematics curriculum or separately (Bocconi et al., 2016). In the context of Iran, except the "work and technology" textbook in grade 9 which has one module (10 pages), there is nothing about computational thinking (CT) in k-12 textbooks in Iran. Although, there is an after-school program in which some students can participate to learn computational thinking skills. So, it can be said computational thinking (CT) is neglected in the school curriculum in Iran and can be considered as a "null curriculum" in terms of Eisner (2004). Therefore, it seems necessary to consider computational thinking (CT) as a component across curriculum and textbooks in k-12. Although different countries have different issues and problems to each other and curriculum developers must keep in mind local issues and local considerations (such as cultural components, environmental challenges, natural disasters, and so on), but they also have to prepare their citizens for 21st-century requirements. In this regard, it seems CT is a necessary skill for Iranian students in the 21st-century.

Finally, the findings of this retrospective cultural historical review and its practical implications can inform international scholars in two ways. Firstly, this paper informs the bigger mathematics education community with the Iranian community as developing countries to integrate CT into the official curriculum. This can encourage other developing countries to start to teach CT for their future generation. Secondly, the finding of this study can help scholars in developed countries for designing a better program for migrant students who spent some part of their studies in developing countries.

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