Revista Publicando, 5 No 16. (2). 2018, 526-537. ISSN 1390-9304

The rise and fall of geometry in schools in iran during the years 1925-2016

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Abstract

The formal education of geometry in Iran dates back to 1927 and the establishment of the Dar ul-Funun school. At that time, due to the presence of French instructors, the compilation of mathematical books was influenced by educational programs in France. Euclidean geometry was developed based on the Euclid's axioms, and was placed in the curriculum from the first year. In 1938, a more innovative and reformist program was adopted in which geometry of cones, digital geometry and descriptive geometry were included. In 1971, a great transformation took place in the compilation of mathematical textbooks, which arose from the emergence of a group of French mathematicians known as Bourbaki. This group, which was strongly opposed to Euclidean geometry in its classical way, led to the introduction of mathematical concepts to students in a more abstract manner and without preparation for meaningful understanding. Under the influence of this group, descriptive and digital geometries were removed from the curriculum, but traditional geometry remained. By the year 1992, the volume of books and their teaching hours were reduced, but since 1993, this decline has been more severe. Now all the countries of the world have realized the importance of geometry in fostering students' thinking and creativity for its use in new physics theories, including superstrings, and they consider it as the best setting to publicize mathematics in the society. Using dynamic software, they have made the teaching of geometry for students more productive and more enjoyable. There have also been some positive developments in our country. However, the training of specialized teachers in geometry should also be considered in order to improve the quality of teaching geometry.

Keywords: Geometry textbooks, Transformation of mathematics curriculum, Dynamic software, specialized teachers in geometry

Received 07/08/2018
Approved 08/10/2018

Revista Publicando, 5 No 16. (2). 2018, 526-537. ISSN 1390-9304

Introduction

Throughout history, the geometry has always been of great importance in people's lives, and has been considered as a tool for understanding, describing and interacting with the space in which human beings live (Duatepe, 2004). National Council of Teachers of Mathematics (2000) emphasizes the importance of geometry in school mathematics, and acknowledges that teaching geometry is an opportunity for development of reasoning and intellectual skills of students. Geometry is one of the most important subjects in school mathematics, which by having a fixed position, has dedicated a considerable amount of school mathematics curriculum to itself (Reyhani et al., 2010). Sherrard (1981) considers geometry to be an essential skill in mathematics because of the importance it has for each person. Generally, students do not like geometry and they do not succeed in it. Ma & Kishir (1997) in their research showed that students learn something effectively that they are interested in. Bergeson, Fitton and Bylsma (2000) state that a negative attitude toward mathematics in learners is created when learners do not have a good view, as well as a tendency to mathematics. Geometry is one of the topics of math course, in which students who have a lower attitude towards it are even less progressive (Duatepe & Behiye, 2007). In general, teacher-centered geometry teaching is procedural and prescriptive (Baynes, 1998; Keiser, 1998; mayberry, 1983). These methods limit the growth of creativity, visualization and perception (Keiser, 1997; National Council of Teachers of Mathematics, 2000). Schoenfeld (1983) also confirms the belief that students can not have enough creativity in traditional classes. In addition, this approach is problematic for many students and teachers, and both groups regard geometry as a catastrophic topic (Malloy & Feriel, 1999). Schoenfeld (1983) regards the limitations of traditional methods of teaching mathematics to teacher-centered teaching and presentation of prepared information to students. High school geometry course has always been one of the courses that students in Iran have had difficulty with (Zohori Zangene & Gouya, 1995). Many research evidence clearly suggest that many students do not learn geometry as expected (Prescott et al., 2002; Thirumurthy, 2003; Ubuz and Ustün, 2003; Mitchelmore, 1997).

Research background

Several studies have been considered in this regard, to which we mention a few. Results and findings of the third international study of mathematics and science (Times) in the academic year of 1994-1995 and repeated study of Times-R in the years 1999-2000 also emphasized the weakness of the performance of Iranian students in the field of mathematics. The results of studies in 1994-1995 showed that among 41 countries participated in mathematics course, Iran was ranked 37th in second grade of middle school and 38th in the third grade of middle school (Kiamanesh & Noori, 1997 and (Abisheva et al., 2018). This means that Iranian students in math performance have not been very successful. To address this problem, as well as to enhance the progress of students in geometry, it is imperative for teachers to understand that the needs and interests of today's kids are far different from those of past decades (National Council of Teachers of Mathematics, 1989;2000).

Received 07/08/2018
Approved 08/10/2018

Revista Publicando, 5 No 16. (2). 2018, 526-537. ISSN 1390-9304

Research objective

In this paper, we examine the historical course of the changes in the geometry textbooks in high schools since 1928, as well as quantitative and qualitative reduction process of books, and why and how to revive geometry in schools.

Research questions

1- What reasons have caused the reduction of geometry in the schools?
2- Why should geometry return to schools?
3- How we can bring back geometry to schools more refreshingly by a new approach?

Research methodology

The paper is done by descriptive-analytical method and from library resources. After identifying the main sources and new researches, notes are taken from their contents related to the research topic and are organized in terms of sequencing and time symmetry. Then, their validity was examined and after evaluating and analyzing the credible information obtained about the research topic, the final analysis was made in the conclusion section. Here we review the changes in geometry textbooks, their effects, the expression of comments, perspectives, and reasons for the authors of geometry books in different periods.

1- 1851 to 1925 (a look at the history of geometry in Iran)

In the 19th century, European mathematics was at a high degree of progress with the advent of greats such as Gauss (Hasani, 2014).

Table 1. *Historical periods of geometry in Europe*

1780	Lagrange (Calculus of variations - Differential geometry)
1794	Monge (Projective Geometry)
1800	Gauss (Constructible polygons - Non-Euclidean geometry - Fundamental theorem of algebra)
1803	Carnot (Modern geometry)
1805	Legendre (Principles of geometry - Elliptic function)
1822	Poncelet (Projective geometry - Feuerbach's theorem)
1829	Lobachevsky (Non-Euclidean geometry)

The Dar ul-Funun School was opened in 1851. After a few years of teaching by foreign professors, the first book of Euclidean geometry was published by the engineer Abdul Rassol Khan, and based on the lessons of Austrian Monsieur Buhler in 1273 AH. Also, the book "Principles of Geometry" was published by Aqamirza Abdulghaffar Najm al-Dawlah in 1292 AH. This book has 142 pages and consists of 8 chapters, the main contents of which are the properties of lines, angles, circular properties, polygon properties, area, similarity, and regular polygons. In Dar ul-Funun, they taught geometry by the axiomatic method. The use of algebraic proofs was not permissible to explain

Received 07/08/2018
Approved 08/10/2018

geometric theorems and analytical geometry was called “the stick of the blinds” (Zohori Zangene, 2002). There is a big flaw in the Dar ul-Funun! The Dar ul-Funun is established and high science is founded in it, while students have not yet completed primary and secondary educations, and the high education courses of Dar ul-Funun have no basis and foundation (DolatAbadi, 1983).

2- 1925 to 1938 (first curriculum design)

In the school year of 1924-1925, the number of schools was 2,336 and the number of students reached 108,959. In the same period, the order of 6-year education was approved on August 7, 1927. In the formal curriculum, the syllabus of each course show that the planners have not yet been acquainted with the findings of the new educational science (Taher Ahmadi, 1999 and (Antúnez, 2016)

Table 2. *The table of contents of geometry textbooks for students in the first codified curriculum in 1927*

First year	Definition of point, line, level and volume, definition of geometric location, states of equation of two triangles, quadrilaterals and their types, the point of intersection of heights and medians
Second year	Circle, decisive and tangent, the central, inscribed and intercepted angles, The situation of two circles, the area of the quadrilateral, and the Pythagorean theorem
Third year	Proportionality and similarity, page, common limit of two pages, theorem of three perpendiculars and oblique, relative state of the two pages, definition of geometric bodies and way of the calculation volume and volume without reasoning
Fourth year	Cut off and tangent properties in the circle, the strength of the point relative to the circle, the main axis of two circles, vectors (very briefly), Chasles' Relation, symmetry and consensus
Fifth year	Platonic bodies, prism level, prism, pyramid, imperfect pyramid and spherical sections

Table 3. *Hours of math lessons in the first curriculum codified in 1927*

Lesson	First year	Second year	Third year	Fourth year	Fifth year
Arithmetic	3	1	-	-	-
Geometry	2	2	2	2	1
Algebra	-	2	2	2	1
Trigonometry	-	-	-	1	2

Received 07/08/2018
Approved 08/10/2018

Revista Publicando, 5 No 16. (2). 2018, 526-537. ISSN 1390-9304

Math and science textbooks at this time were heavily influenced by French scientific culture. The reasons for this were the French pamphlets remaining from the Dar ul-Funun and the familiarity of most of educated Iranians with the French language. In the year 1933, the late Hoorfar and Majzoub also compiled the book of descriptive and digital geometry (Jalili, 2004).

3- 1938 to 1962 (the diversity in compilation of textbook)

In the last years of Reza Shah's rule, another curriculum for complete secondary education was written and developed. According to this curriculum, which was adopted by the Supreme Council of Culture on November 1938, and was strongly influenced by the modernist reforms of that time, the last year of secondary education, which had already been divided into two periods of three years, had a special aspect and included three branches of literature, mathematics and natural sciences (Taherahmadi, 1999). In the sixth year curriculum, 11 hours in mathematical branch and 4 hours in experimental branch were devoted to mathematics, drawing and geometry courses.

Table 4. Table of contents of geometry textbooks in curriculum of 1938 (Supreme Council of Education 1938)

Geometry of Conics	Vectors, spatial coordinates of a point, angles between two vectors, multiplication of vectors, cone sections, strength of the point relative to the circle, Menelaus's theorem and Ceva's theorem
Digital geometry	The image of the point relative to the page, line display, the common page between two pages and common page between line and page
Draw geometry	Image of the page on the horizontal page, changing the image of the page, the rotation around the axis perpendicular to the image of the page, common perpendicular of two skew lines

From the year 1941 (occupation of Iran) until 1945, the government lost its ability to continue to support the compilation of textbooks. Printers and publishers began publishing various books. This led to diversity of textbooks. For example, in the same years, the geometry was drafted by seven groups of authors for the third year of high school and with a list of contents such as (ratio and proportionality, Thales's theorem, similar shapes, a brief description of mapping, line and page, polygons and rotary objects). Therefore, in 1945, the Ministry of Culture, under the pressure of publishers and booksellers, announced the freedom to publication of textbooks.

4- 1962 to 1975 (changing of the educational system)

4-1 Change in the educational system in Iran

In the same period, under the influence of international developments, in 1975, the planning to change the structure of the educational system from 6-6 to 4-3-5 was conducted, which was implemented from 1971. Although the textbooks of the new high school system, which entered in

Received 07/08/2018
Approved 08/10/2018

Revista Publicando, 5 No 16. (2). 2018, 526-537. ISSN 1390-9304

schools in September 1974, had been compiled at the time of full penetration of American education, but the content and method of presenting geometry and algebra continued almost similar to the past. The only minor changes in geometry was that instead of the definition of Buzjani from the angle, its new American form (oxUoy) was used. Because the compilation of 120 high-school textbooks needed enough time, it was decided to select one book for teaching of each branch, which this textbook was previously compiled and taught so far. Among the selected geometry books there was the geometry of the fifth year of natural and literary (Mohammad Baqer Azgami, Gholamreza Behnia, Parviz Shahriari, Aliasghar Shikhrezayi), that consisted of 80 pages and included five chapters (definition of a line and a page, the state of two pages, Thales's theorem in space, polygons). Out of the feature of this book is that it contains only definitions and theorems without student's practices. Fourth mathematical geometry (Mousa Azarnoosh, Ahmad Birashk, Jahangir Shams Azari, Abdul Ghani Alim Marvesti, Professor Taghi Fatemi, Baqir Nahvi, Mohsen Honarbakh) has 276 pages and includes the definition of the conventional principle, definition of axiom principle, the definition of theorem, circle, area, triangular inequality, important quadrangles, longitudinal relation in circle, and calculation of length of triangular sub-elements. Out of the features of this books are attention to definitions, intuition in mathematics and many exercises for solving by the student. By more generalization of the education, the number of students gradually increased, still, the same old curriculum which was developed for elites was taught with little changes. In such a situation, geometry attracted a few students, and only a few could solve the problems of geometry and learn the concepts. This included a maximum of 10% of mathematics, in which students who were interested in geometry accounted for 10% of all students; That is, except for about 10%, the rest of the students were able to pass this lesson by memorizing the theories, which included at least 10 test scores for this course (this included 17 scores out of 20 in geometry of conics of the sixth grade) (Zohori Zangeneh, 2002).

4-2 The emergence of the Bourbaki and the beginning of the global revolution in new mathematics

Until the year 1957 and the birth of the Bourbaki group, the famous slogan of Plato " Let no one unversed in geometry enter here" was valid and countable for all mathematicians. In Iran, plenty of rich geometry textbooks were taught in high schools (Bourbaki was a group of French mathematicians, which its members were not completely known). Their goal was to determine the path of mathematics to their liking and initiative, which partly succeeded in this path. They refused to use figure and charts in their writings and books. This was one of the reasons that they were opposed to Euclidean geometry in its classical form. After Jean-Paul Daidone, in 1958, said the famous slogan “Damn Euclid and death to the triangle”, this slogan led to a dramatic reduction in the volume of teaching geometry in high schools in most countries, including Iran. Only countries such as the former Soviet Union, Italy, the Netherlands and several other countries did not surrender to this slogan. Before proposing this slogan, we should look at what outstanding mathematicians, including the Bourbakies themselves, were born in the world, all of whom have studied geometry in high school, and compare them with mathematicians of the time of geometric

Received 07/08/2018
Approved 08/10/2018

Revista Publicando, 5 No 16. (2). 2018, 526-537. ISSN 1390-9304

absenteeism, which are often specialists in a particular branch of mathematics, and even with those who receive the Fields medal. Since then, the authors of the textbooks also began to diminish geometry in textbooks. Our authors and professors, influenced by the French mathematics curriculum, began to change their curriculum (Karamzadeh, 2002).

Figure 1. *Members of the Bourbaki group*

5- 1975 to 1992 (introduction of new mathematics to Iran)

The arrival of new mathematics in Iran dates back to 1963 and with the publication of the book "Introductions to New Analysis" by Dr. Vazgen Avanessian, professor at the newly established National University at that time. Then, in 1965, Dr. Gholam Hossein Mosaheb published the book, titled "Madkhal mantegh sourat (Mathematical logic)". Although this book was not completely mathematical, but it included many mathematical concepts. After studying several volumes of the new mathematical book, Mr. Asjadi wrote a book titled "The Basics of Logic and New Mathematics" by using old and new books and with the help of Mr. Mosaheb (director of the Mathematical Journal of Yekan) in 1969. After this, other books like this got popular and the new mathematical era begins in the country (Asjadi, 1984). In 1971, mathematical curriculums from different countries, as well as their books were reviewed. In the new mathematical curriculum, math concepts were introduced unambiguously and without contextualization for meaningful understanding of them by students, and the main focus was on the set theory, while the main focus in the mathematics curriculum prior to the new mathematical movement was on arithmetic (Rafiepour, 2014). Secondary school math textbooks have been re-written and republished for all secondary schools. These books were compiled by the order of Iran Textbooks Organization as follows:

Received 07/08/2018
Approved 08/10/2018

Revista Publicando, 5 No 16. (2). 2018, 526-537. ISSN 1390-9304

- Arithmetic and algebra (first, second and third): Abolqasem Ghorbani;
- Geometry (first, second and third): Ahmad Birshak and Mohammad Taher Mo'airi;
- Trigonometry (second and third): Ali Hasanzadeh Makoiee, Houshang Taheri and Ahmad Firouznia;
- Algebra and analysis (fourth): Gholamreza Asjadi, Jalilollah Qaragoslu and Hedayat Mousavi;
- Analytic Geometry (fourth): Hossein Ghayour, Hossein Majzoob Zanjani and Mohammad Taher Mo'airi;
- New Mathematics (First, Second, Third, and Fourth): Farshid Minbashian and Mirza Jalili.

The mathematics curriculum of the educational system was changed, and mathematics regardless of logic and set theory entered into the high school curriculum. Some geometry courses such as descriptive and digital geometry were removed from the high school curriculum, but traditional geometry remained in its place. Only geometry of the cones, instead of hybrid view, turned into geometry of the cones with analytical view. The technical drawing, which had strong geometric intuition in it, was also eliminated.

Authors and scholars of the time had different opinions about the changes in the mathematical curriculum. Major and hasty changes were made. Of the problems are the following:

1- Short and inadequate time to write new books
2- Decreased hours of teaching math
3- Considering the topic of trigonometry as independent and emphasis on the teaching of so-called trigonometric identities
4- Considering new mathematics as an independent branch of mathematics.

Therefore, problems like these led to changes in geometry textbooks every year since then (Moshefi, 1985). Their creators have worked hard and have gone forward with time. Instead, it was better to use the phrase "a new way in mathematics". This way is not smoother, easier and more beautiful than the old way. Although I myself have little share in this change, I see now that there has been exaggerated in this way (Qaragoslu, 1989).

After the presentation of the plan and report of the Geometry Commission to the General Council, this was discussed at sessions No. 21, 22, and 23 of this Council dated January 11 and January 25 of 1989 and February 8 of 1990. At the General Council meetings, especially on what kind of geometry should be taught in this four-year period, there were ongoing discussions that resulted in the following goals:

1- Introducing the most familiar and oldest example of a deductive science
2- Presentation of geometry in a way that improves student intuition and at the same time does not limit their talents and mental abilities.

Received 07/08/2018
Approved 08/10/2018

Revista Publicando, 5 No 16. (2). 2018, 526-537. ISSN 1390-9304

3- Presentation of geometry as a science of aesthetics in the form of topics such as similarity, symmetry, etc.

The authors of the geometry textbooks of this period, in the first to third years were Ahmad Birshak and Mohammad Taher Mo'airi, and in the mathematical fourth year in the analytic geometry were Hossein Ghayour, Hossein Majezoub Zanjani and Mohammad Taher Mo'airi. Significant features of the geometry textbooks of this period included the existence of many exercises at the end of each chapter, as well as a brief acquaintance with the history of geometry. However, the new mathematics curriculum failed in most countries, but in Iran it lasted for about 20 years. The problems in this educational system were over-conceptualism and beyond the power and capacity of the students. In order to solve these problems, in January of 1991, a new educational system was approved by the Supreme Council of the Cultural Revolution. According to the resolution, the elementary school determined as 6 years (basic), middle school as 3 years (pillars), secondary school as 3 years (senior) and pre-university as one year. Perhaps because of executive problems, the change in the educational system since 1992 was limited to changing the textbooks of high school and pre-university courses. In 1990, Nasiri, Khosravi, Darabi and other authors began writing new generation of geometry textbooks, and wanted to transform geometry, but this change lasted a few years due to the lack of preparation of the teachers. Although, other problem was that books of Geometry 1 and 2 were presented in the first and second year of the secondary, respectively. But correctly, years later, they were given in the second and third year of secondary education (Nasiri, 2016). The major problem in the compilation of these books was their commonality for all mathematical disciplines of physics, experimental, humanities and other disciplines. After announcing the evaluation results of the mathematics 1 and 2 courses and Geometry 1 and Geometry 2, Mathematics 1 and 2 were rewritten and summarized in the first few years. Books of Geometry 1 and Geometry 2 (authors: Amir Khosravi, Mahmoud Nasiri, and Ibrahim Darabi) were revised and re-written only one year after their compilation. One of the highlights in the compilation of some new books is the use of the active method. The purpose of this method is to encourage students to continue their work to achieve the final result. The group of authors of books of Geometry 1 and Geometry 2 are Zahra Goya, Soheila Gholam-e Azad, Jafar Niousha, Bijan Zohouri Zanganeh, Javad Hajibaba'I and Roohollah Jahani Pour.

Although it seems that changing the educational system to two secondary periods of first and second and the beginning of the compilation of new textbooks, we should also see changes in the textbooks of geometry in this period.

6- 1992 to 2009 (semester-unit system)

In the theoretical branch of the secondary school, two fundamental changes occurred. One was the separation of the final year or the fourth grade of the high school from the other three, and the other was an experimental semester-unit design for the secondary school, which its experimental implementation began in the academic year of 1992-1993 and became widespread in the country in 1998. Although in 1999, due to various difficulties, the educational system changed to the year-

Received 07/08/2018
Approved 08/10/2018

unit system. The onset of a major decline in geometry from the years 1992 to 1993 started with the departure of good geometry teachers from the teaching cycle. This decline is still observed in the curriculum (Nasiri, 2016). In this curriculum, the compilation of mathematical textbooks has undergone major changes. After one year, the evaluation was carried out and books of Geometry 1 and 2 were recompiled. Also, after the widespread of the "new secondary educational system" in 1998, the textbook of analytic geometry and linear algebra in the pre-university was recompiled after being implemented in a four-year period, and linear algebra attitude was reduced in it.

7- 2009 to 2017

In these years, big decision makers of the country's educational system have a lot of emphasize on content changes, lesson hours, and textbook updates. Although the direct roadmap is not clear, but the diversity of opinions and personal decisions sometimes disrupts the correct, scientific and accurate compilation of textbooks (especially mathematical books). It can be concluded that psychological principles and educational points did not take into account in the preparation of the old books of geometry. The degree of difficulty in the subject of geometry books was such that a small number could reach the diploma level or higher. Many students were dropping out of the schools, which contradicted the ultimate goal of teaching mathematics, that is, generalizing mathematics. The gradual and measured change of mathematical textbooks was imperative and inevitable. But what made this change inappropriate was copying instead of modeling global patterns, as well as the rapid and unannounced entry of unprepared teachers and students into mathematical abstraction.

Conclusion

Results and suggestions of recent study for revival of geometry include:

1- Training of expert teachers in geometry

To revive geometry, the first element is having expert teachers in geometry, which themselves know the geometry very well and teach it well. Today's mathematical teachers are students of the weakening period of geometry, which naturally do not have sufficient mastery of geometric subjects and not enjoy teaching. In fact, the fear from geometry and mathematics is transmitted by weak and less educated teachers (Karamzadeh, 2017). For this purpose, teachers specialized in geometry teaching can be trained in Teacher Education centers, which they also teach math teachers how to correctly teach geometry throughout the country.

2- Foresight in the compilation of mathematics textbooks

In compiling and modifying mathematics textbooks (due to the continuity of curriculum subjects), more care, patience and foresight should be taken into account than other courses. Because the change in the curriculum and secondary mathematics books is like a double-edged sword, which can be beneficial and make progress or it can harm the teaching process.

Received 07/08/2018
Approved 08/10/2018

3- Intellectualization in the teaching of geometry

One of the problems that geometry course has compared to other mathematical courses is drawing a lot of shapes and the precision needed to draw them. Occasionally, failing to draw correct shapes produces completely wrong theorems (but seemingly correct). But today, with the presence of dynamic software such as GeoGebra or Cobra, geometric shapes can be drawn with high accuracy and new relationships and theorems can even be discovered. So, more generalization of these software in the process of teaching geometry in schools will be a great help to progress and improvement of geometry.

Acknowledgments: The authors would like to thank professor O.A.S. Karamzadeh for introducing the topics of this article and for his helpful conversation during the preparation of this article.

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Received 07/08/2018
Approved 08/10/2018