

## CHAPTER SEVEN

### COMPARATIVE STUDIES

#### 7.1. Retrospective of the Development of School Mathematics Education in the Second Half of the XXth Century and Until Now

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The development of a society is priori impossible without certain changes in its life spheres including education. The reform of school mathematics education has a special role in this context.

The reform of school education, including mathematical, and integration into the world education community require from the modern school to solve the urgent tasks of improving the quality of school education. To implement the tasks set in the State Target Program of Improving the Quality of School Natural Sciences and Mathematics Education until 2015, the State Standard of Secondary Education (second generation) and other public documents, it is important to study the experience of the world's best education systems, including the state, trends and patterns of education development in different countries, geopolitical regions and in the world as a whole. It is this aspect that is the study subject of comparative pedagogy as a branch of pedagogical science. The use of basic conceptual principles of comparative pedagogy for the research of trends and the development of national and foreign school mathematics education will enable to expand the boundaries of cross-sector analysis and synthesis and to get new data for improving the system of mathematics education in Ukraine.

We focus our attention on three periods of reforming the content of school mathematics education in the second half of the XX century and the beginning of the XXI century that are associated with the direct participation of the scientists of the Bohdan Khmelnytsky National University at Cherkasy in creating school programs and textbooks for secondary schools.

**The period of Kolmogorov's reform (60-s – 70-s of the XX century).** The reform of school mathematics education in the 60-70-s has a personalized name of Academician A. Kolmogorov, a leading mathematician of the world at that time, a pioneer, chief inspirer and direct executor of theoretical and practical reform measures. The main objective of Kolmogorov's reform was to modernize the content of teaching Mathematics, to bring it closer to the problems of modern science and, to some extent, to move further away from the classic issues having been considered since ancient times. In particular, the following measures were planned: algebraization of Mathematics course in junior school, introduction of differential and integral calculus and probability theory in senior school, the complete reconstruction of Geometry course based on geo-metric transformations and vectors. Therefore, the ways to implement these ideas in contemporary programs and textbooks, especially in Geometry, deserve special attention.

The analysis of the recent research and publications shows that the interest to the phenomenon of Kolmogorov's reform is not reduced. Currently, this period of reforms is a subject of both historical-pedagogical research and the study in the field of didactics and methodology of teaching Mathematics: A. Abramov<sup>1</sup> (2003), D. Dobrov<sup>2</sup> (2012),

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<sup>1</sup>Abramov, A. M. (2003). *On the status of mathematics education in high school (1978-2003)*. – Moscow: Fazis (in Rus.).

<sup>2</sup>Dobrov, D. (2012). Teaching of Mathematics in school and Kolmogorov's reform: [Online]. Available: <http://www.dm-dobrov.ru/history/mathematics.html> (in Rus.).

T. Kiseleva<sup>3</sup> (2006), S. Kogalovskii<sup>4</sup> (2006), Y. Kolyagin<sup>5</sup> (2001), G. Kondratieva<sup>6</sup> (2009), I. Kostenko<sup>7,8</sup> (2012 & 2014), A. Stolyar<sup>9</sup> (1986), V. Testov<sup>10,11</sup> (2011 & 2015), B. Furtak & D. Zhyvko<sup>12</sup> (2000), V. Zuckerman<sup>13</sup> (2012), R. Cherkasov<sup>14</sup> (1997), etc. However, the scientific exploration of predecessors is not exhaustive in this direction. They can and should be continued with the use of interfield analysis and synthesis, in particular, on the basis of a new direction of theoretical and methodological research in the subject area of “mathematics” – comparative didactics of mathematics<sup>15</sup> (Tarasenkova & Serdyuk, 2013).

According to the periodization of G. Kondratieva<sup>16</sup> (2012), Kolmogorov’s reform in the time of dimension covers two phases (reformist and experimental-eclectic) of new cycle of the development of school mathematics education in the former state, of the second half of the twentieth century.

The beginning of the reform phase (1965) conformed with a significant event of that time – founding the Central Commission of Science Academy and Pedagogical Science Academy of the USSR and determining the content of secondary mathematical education (Chairman – Academician A.I. Markushevych, supervisor and simultaneously the Chairman of the Mathematics Scientific Methodological Council of the USSR Education Ministry – Academician A.M. Kolmogorov).

In 1968, the new program in Mathematics for secondary school was approved and the work on the creation of new textbooks began. In 1970, “The Regulations about Secondary School” was adopted to mark the beginning of the next experimental-eclectic phase of the reform, in the opinion of G.V. Kondratieva<sup>17</sup> (2009).

According to the new curriculums and programs:

- the primary school became a three-year course; “Mathematics” course was

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<sup>3</sup>Kiseleva T. (2006). The problem of periodization in the studies on the history of mathematical education. *Bulletin of Eletski State University named after I.A. Bunin. A series of "History and theory of mathematics education", 11*, 132-140 (in Rus.).

<sup>4</sup>Kogalovskii, S.R. (2006). On the leading plans of teaching mathematics. *Pedagogika (Pedagogy), 1*, 39-48 (in Rus.).

<sup>5</sup>Kolyagin, Y.M. (2001). *Russian school and mathematics education: Our pride is our pain*. Moscow: Prosveshcheniye (in Rus.).

<sup>6</sup>Kondratieva, G.V. (2009). On the problem of the periodization of the development of school mathematics education in Russia. *Bulletin of Moscow State Regional University. "Pedagogy" series, 3*, 124-131 (in Rus.).

<sup>7</sup>Kostenko, I.P. (2012). Reform of school mathematics in 1970-1978 years. On the 40th anniversary of the «Kolmogorov reform». *«Alma mater» (Bulletin of the Higher School)*: [Online]. Available: <https://almavest.ru/ru/node/1256> (in Rus.).

<sup>8</sup>Kostenko, I.P. (2014). 1965 – 1970 years. Organizational preparation of the reform-70 ME, APS, personnel, programs, textbooks (Article Five). *Matematicheskoye obrazovaniye (Math education), 3(71)*, 2–18 (in Rus.).

<sup>9</sup>Stolyar, A. (1986). *Psychology of Mathematics: [lectures]*. Minsk: Vysheyschaya School (in Rus.).

<sup>10</sup>Testov, V.A. (2011). Selection of content of teaching mathematics. *Mathematical methods and models: theory, applications and role in education: collection of scientific works*, 265-273 (in Rus.).

<sup>11</sup>Testov, V.A. (2015). The main aspects of the implementation of the concept of development of mathematics education in the Russian Federation. *Innovative projects and programs in education, 1*: [Online]. Available: <http://cyberleninka.ru/article/n/osnovnye-aspekty-realizatsii-kontseptsii-razvitiya-matematicheskogo-obrazovaniya-v-rossiyskoy-federatsii> (in Rus.).

<sup>12</sup>Furtak, B. & Zhyvko D. (2000). New approaches to the content of mathematics education in Ukraine. *Matematyka v shkoli (Mathematics in school), 5*, 24-30 (in Ukr.).

<sup>13</sup>Zuckerman, V. (2012). Kolmogorov's Reforma and school mathematics education today. *Library "Moscow State University for School"*: [Online]. Available: <http://lib.teacher.msu.ru/pub/2330> (in Rus.).

<sup>14</sup>Cherkasov, R.S. (1997). The history of national school math education. *Matematika v shkole (Mathematics at school), 4, 5, 6* (in Rus.).

<sup>15</sup>Tarasenkova, N.A., Serdyuk, Z.O. (2013). The basis of comparative pedagogy in mathematical education of different countries investigation. *Didactics of mathematics: problems and research: international collection of scientific works*, 40, 55–59 (in Ukr.).

<sup>16</sup>Kostenko, I.P. (2012). Reform of school mathematics in 1970-1978 years. On the 40th anniversary of the «Kolmogorov reform». *«Alma mater» (Bulletin of the Higher School)*: [Online]. Available: <https://almavest.ru/ru/node/1256>

<sup>17</sup>Kondratieva, G.V. (2009). On the problem of the periodization of the development of school mathematics education in Russia. *Bulletin of Moscow State Regional University. "Pedagogy" series, 3*, 124-131 (in Rus.).

introduced replacing Arithmetic (*now, primary school is a four-year course*);

- the structure and the names of the systematic course components in Mathematics: grades 4-5 – propaedeutic course of “Mathematics” with elements of Algebra and Geometry; grades 6-8 – systematic courses of “Algebra” and “Geometry” (Planimetry), grades 9-10 – systematic courses of “Algebra and Analysis Introduction” and “Geometry” (Stereometry) (*the changes have been preserved*);

- the construction of the course became linear-concentric (*the changes have been preserved*);

- set Theory and Mathematical Logic acquired the status of fundamental principles and were used as the primary language of the content (*the changes have not been preserved*);

- archaic issues were removed from the courses (for example, the algorithm of extracting the square root of the number) (*the changes have been preserved*);

- the program included some questions about computers and programming (*the changes have not been preserved, but in the modern curriculum of secondary education, there is a discipline “Informatics”*);

- a new form of education, optional courses, were offered; they were “Related Sections and Questions of Mathematics” (the expansion of some program themes) and “Selected Issues of Mathematics” (programming, computational mathematics, vector algebra, linear programming problems) (*the changes have been preserved and developed*);

- the mark for mastering optional courses gained official status and was recorded in the secondary education certificate (*the changes have not been preserved*);

- a system of schools and classes with advanced theoretical and practical study of certain subjects, including Mathematics, which was launched in 1959, in 1966 was completed with Physics-Mathematics boarding schools that were created at leading universities (*the changes have been preserved*).

Trial textbooks in Geometry for grades 6, 7 and 8 by O.F. Semenovych<sup>18 19 20</sup> (1961; 1962; 1963) were published in 1961-1963, three years before approving the programs. Those textbooks were created based on the current programs (not Kolmogorov’s one); however, according to the Academicians V.M. Glushkov and S.M. Chernikov<sup>21</sup> (2010, by Preprint, 1970), those textbooks reflected the new tendencies that later formed the basis for new programs in the secondary school Geometry. On the basis of these books, the author team consisting of O.F. Semenovych, F.F. Nagibin and R.S. Cherkasov developed and submitted to the contest the textbook of Geometry for 8-year school, where it received the second prize of the Ministry of Education of the RSFSR (the first prize was not awarded to any textbook). A.M. Kolmogorov highly appreciated the authors’ attempt to form the school course in Geometry on theory-set basis with wide involvement of geometric transformations and vectors and invited those authors to cooperate. The author team headed by A.M. Kolmogorov was created and worked to form and improve the textbook in Geometry for grades 6, 7 and 8 in the middle of 60-s – early 80-s. The textbooks were published in separate books and were tested in experimental study in the respective forms of the national secondary schools. Experimental data were collected every year, on the basis of which the author team made adjustments in the textbooks. About 10 samples of the trial textbooks were

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<sup>18</sup>Semenovich, A.F. (1961). *Geometry. Trial textbook for the sixth grade*. Ulyanovsk, 164 p. (in Rus.).

<sup>19</sup>Semenovich, A.F. (1962). *Geometry. Trial textbook for the seventh grade*. Ulyanovsk, 94 p. (in Rus.).

<sup>20</sup>Semenovich, A.F. (1963). *Geometry. Trial textbook for the eighth grade*. Ulyanovsk, 90 p. (in Rus.).

<sup>21</sup>Glushkov, V.M., Chernikov, S.N. (2010). Review about scientific and pedagogical activity of head of the department of geometry and mathematics teaching methods Cherkasy Pedagogical Institute, candidate of physical and mathematical sciences, associate professor Semenovich A.F.: [Preprint, 1970]. *International scientific and methodical conference “Problems of mathematical education” (PME – 2010), Cherkasy, 24-26 November 2010* (in Rus.).

published for each grade. The top of this process was the textbook “Geometry 6-8”<sup>22</sup> (1979), which was published in almost 20 languages.

We point out that the creative contribution of O.F. Semenovych is 150 published works, 81 of which are separate editions. These works focus on the problems: 1) fundamentals of Geometry and geometric constructions in hyperbolic plane; 2) teaching Geometry in the pedagogical institutes, particularly, 12 books in Projective Geometry and the Fundamentals of Geometry; 3) teaching Mathematics in secondary school: the textbooks in Geometry, teachers’ books, books and articles for schoolchildren, students of pedagogical institutes, teachers. Most works by O. Fedorovych have not lost their value now.

We characterize the structure-content features of plane geometry course implemented in this textbook.

Learning material for each grade is presented in some program themes (they are presented as chapters in the textbook)<sup>7</sup> including:

- in the 6<sup>th</sup> grade, the themes are “Elementary Notions of Geometry”, Congruence of Figures and Motion”;

- in the 7<sup>th</sup> grade, the themes are “Parallelism and Parallel Transfer”, “Polygon”, “Vector”, Similarity”;

- in the 8<sup>th</sup> grade, the themes are “Turns and Trigonometric Functions”, “Metric Relations in a Triangle”, “Incircle and Excircle Polygons”, “Initial Information in Stereometry”.

Each program theme is divided into paragraphs, which are divided into items. The exception is the first and the fifth themes, in which the division of the learning material into paragraphs is not provided; however, there are from 7 (theme “Vectors”) till 14 (theme “Elementary Notions of Geometry”) items here. In general, there are 100 items in the textbook. Every program theme involves an item (not always the last one) with additional (extracurricular) material. At the end of each paragraph, there is an item (without a number) “Additional Tasks to the Paragraph”. At the end of the textbook before appendices, there are “Tasks to test course knowledge of grades 6-8” and answers. Some additional information and reference materials, e.g. “About Logical Construction of Geometry”, “Language of Set Theory in Geometry”, are placed at ten pages of “Appendices”.

There are theoretical materials, questions and tasks to develop students’ knowledge and skills in the structure of each item. The amount of learning content is small and designed mostly for one lesson. The questions on theoretical material and tasks are not separated but intertwined forming one unit. Clear and hidden differentiation of tasks according to the degree of their difficulty is used in the sets of tasks. The tasks for oral solving are marked with a “nought” at the number of a task; the tasks of high complexity are marked with a “star”. Internal differentiation is realized through increasing the complexity of the tasks hidden for students – each next task is more complex than the previous one according to the content and operationally.

We should point out that in the modern Ukrainian textbooks in Geometry, more detailed sections are applied and other sections are offered<sup>23</sup> (Kolmogorov, Semenovich, & Cherkasov, 1979). For example, in the textbook of Geometry for grade 7<sup>24</sup> (Burda & Tarasenkova, 2007) (corresponds to grade 6 in 60-s – 70-s of the XX century), there are four chapters with learning material and the following separate sections of the book: opening remarks to the students, summary tables and tasks to repeat the studied material

<sup>22</sup>Kolmogorov, A.N., Semenovich, A.F., Cherkasov, R.S. (1979). *Geometry: Textbook for 6-8 grades of the secondary school*. Moscow: Prosveshcheniye, 382 p. (in Rus.).

<sup>23</sup>Kolmogorov, A.N., Semenovich, A.F., Cherkasov, R.S. (1979). *Geometry: Textbook for 6-8 grades of the secondary school*. Moscow: Prosveshcheniye, 382 p. (in Rus.).

<sup>24</sup>Burda, M.I., Tarasenkova, N.A. (2007). *Geometry. Textbook for the 7th grade of the secondary school*. Kyiv: Publishing House "Osvita", 208 p. (in Ukr.).

at the end of the school year, answers and subject index. Each chapter starts with a heading “In the Chapter you will learn“, the instructional material is placed in some paragraphs, and a chapter is completed with test questions and test tasks. Each paragraph contains learning material that students have to learn, additional information (section “Learn More”), test questions (section “General Recall”), and the tasks for practicing skills (section “Solve the problem”).

The section “Learn more” includes: interesting material of the theme to be learnt, the related material of extracurricular character; the data of names and symbols origin; historical information; biographies of outstanding national and foreign mathematicians. The main unit of the tasks to a paragraph contains the tasks of four complexity levels. The first level is indicated by a stroke; they are largely oral tasks. The second level is marked with a nought; it is a compulsory task for training basic skills. The third level has no signs. These tasks correspond to sufficient level of students’ academic achievements. The fourth level is marked with a star; they are the tasks of high complexity level that allow students to demonstrate their mathematical abilities. In the textbook, the tasks are given in a traditional text form and in the forms of tables and are based on drawings. Some problems of a paragraph are in bold type. They are basic tasks (task-facts). Students should remember their formulation. These geometric statements can be applied to solving other problems. The methods of solving problems are given in not only the text of the paragraph, but in the unit of tasks for training skills. In addition to the main unit, the tasks of practical character are offered to each paragraph (section “Apply in practice”).

Thus, the apparatus for the organization of mastering and the apparatus of orientation in modern textbooks is more descriptive and detailed compared to the textbooks of the time of Kolmogorov’s reform. Let us consider the peculiarities of the contents disclosure of several initial items of the first program themes “Elementary Notions of Geometry” in the textbook<sup>25</sup> (Kolmogorov, Semenovich, & Cherkasov, 1979). As we have noted, the authors identified 14 items in this theme, including:

- 1) what is the geometric figure;
- 2) the basic concepts that are accepted without definitions;
- 3) magnitudes and numbers;
- 4) the basic properties of distances;
- 5) the relative position of three points on the line, triangle inequality;
- 6) a line segment and a ray;
- 7) coordinates on the line;
- 8) polygonal chain;
- 9) plain, planimetrics;
- 10) range;
- 11) polygon;
- 12) half-plane angle;
- 13) relative position of two circles;
- 14) from the history of geometry.

The main initial ideas of the author’s conception of a content construction and its deployment in the book become apparent when considering the first three points of the first section.

**The period of reforms in 80-s – 90-s of the XX century.** In this period, there was a tendency to unload the content of mathematical education and to increase its practical focus that was reflected in new programs in Mathematics for secondary schools of 1980 and 1985. In these programs, the changes concerned not only the content of education but the structure of the program (including the new chapters “The organization of

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<sup>25</sup>Kolmogorov, A.N., Semenovich, A.F., Cherkasov, R.S. (1979). *Geometry: Textbook for 6-8 grades of the secondary school*. Moscow: Prosveshcheniye, 382 p. (in Rus.).

educational process”, “Guidelines for knowledge assessment”, “Intersubject links”, etc.). During the reforms of that period, 1989 became a turning point to some extent due to the adoption of a new Concept of school mathematics education. The ideas of humanization and humanitarization of education including mathematical education acquired the status of central ones. According to the idea of humanization, mathematics had to become rather a way of the existence and general culture of every citizen of a society than the goal of study; and its study had to provide an equal opportunity for every student to develop their personalities. According to another conceptual idea, differentiated approach was the basis of reforming educational branch “Mathematics” in secondary education; attention to the organization of multilevel study of the course was intensified within both various profiles of training the students of senior school and within one profile. Invariant component (in the classroom – within the curriculum) and variant (in extracurricular time – through optional classes, mathematical circles, extramural mathematical schools, individual and group work with gifted students, etc.) component of education were distinguished. Great attention was paid to school mathematical education of “high level”. The advanced study of Mathematics became possible since grade 8.

In this period, there was a peak of creative activity of Kovalenko Volodymyr Gavriloivich (1932-1994), a Candidate of Pedagogical Sciences, Assistant Professor, the Honored Teacher of the USSR, the Head of Geometry and Mathematics Teaching Methods the Department (Mathematics Department since 1987) of the Cherkasy National University, in scientific research. His teacher guides “Mathematical Symbols” (co-author I.F. Sledzynsky, ed. I.F. Teslenko. – K.: Radyans'ka Shkola, 1981), “Problem Approach to Teaching Mathematics” (co-author I.F. Teslenko. – K.: Radyans'ka Shkola, 1985), “Didactic Games at Mathematics Lesson” (M.: Prosveshchenie, 1990); student’s and teacher’s book “Geometric Transformation of a Plane” (co-author O.F. Semenovych. – K.: Vyscha Shkola, 1993. – A series of “Library of Physical and Mathematical School. Mathematics”) were published. V.G. Kovalenko described his ideas and the obtained results in a number of articles, materials and abstracts.

However, the main achievement of V.G. Kovalenko was and has been the first (in Ukraine) experimental textbooks for the advanced learning of Algebra in grade 8<sup>26</sup> (Kovalenko, Krivosheev & Lembersky, 1991) and grade 9<sup>27</sup> (Kovalenko, Krivosheev & Lembersky, 1992). These textbooks were created together with well-known, in Cherkasy Region, experienced Mathematics teachers V.Y. Kryvosheiev and L.Y. Lembersky, and with an expert in IT-sphere O.V. Staroseltseva. Nowadays, many teachers use these books as a source of additional information and successful set of exercises and tasks.

**The modern stage of reforming a school mathematical education** is characterized by numerous changes in both the main conceptual principles of the reforms and the ways of their implementation in practice that requires special discussion and is beyond the scope of this article. However, the participation of scientists of the Cherkasy National University in the development of the content of school mathematical education cannot be overlooked. We can affirm that a group of associates, who dedicated themselves to the development of school mathematical education in Ukraine, was formed at the Physics and Mathematics Department of the Cherkasy National University (ChNU). The textbooks of this writing team became the winners of the all-Ukrainian competition of school textbooks including

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<sup>26</sup>Kovalenko, V.G., Krivosheev, V.Y., Lembersky, L.Y. (1991). *Algebra. 8th grade: experimental textbook for schools with advanced study of mathematics and special schools of Physics and Mathematics profile*. Kyiv, education «Osvita», 302 p. (in Ukr.).

<sup>27</sup>Kovalenko, V.G., Krivosheev, V.Y., Staroseltseva, A.V. (1992). *Algebra. 8th grade: experimental textbook for schools with advanced study of mathematics and special schools of Physics and Mathematics profile*. Kyiv, education «Osvita», 271 p. (in Ukr.).

the textbook in Mathematics for grade 5<sup>28</sup> (Tarasenkova, Bochko, Bogatyreva, Kolomiets & Serdiuk, 2013) and grade 6<sup>29</sup> (Tarasenkova, Bogatyreva, Kolomiets & Serdiuk, 2014), the textbook in Algebra for grade 7<sup>30</sup> (Tarasenkova, Bogatyreva, Kolomiets & Serdiuk, 2015) and grade 8<sup>31</sup> (Tarasenkova, Bogatyreva, Kolomiets & Serdiuk, 2015), the integrated textbook in Geometry for grade 11 (academic and profile levels)<sup>32</sup> (Burda, Tarasenkova, Bogatyreva, Kolomiets & Serdiuk, 2013). Didactic support in the form of a series of teaching and learning aids for teachers and students of secondary schools was developed for each textbook. Totally, over 100 textbooks were published including 70 ones recommended by the Ministry of Education and Science of Ukraine.

In 2015, the writing team including N.A. Tarasenkova (ChNU), M.I. Burda (the Institute of Pedagogics of Ukraine National Academy of Pedagogical Sciences), O.I. Hlobin (the Institute of Pedagogics of the National Academy of Pedagogical Sciences of Ukraine), I.M. Bohatyreva (ChNU), O.M. Kolomiets (ChNU), Z.O. Serdiuk (ChNU) developed a concept and innovative set of textbooks of a series “Test of Subject Competences” in Mathematics for grade 5<sup>33</sup> (Tarasenkova, Bogatyreva, Kolomiets & Serdiuk, 2015) and grade 6<sup>34</sup> (Tarasenkova, Bogatyreva, Kolomiets & Serdiuk, 2015), in Algebra for grade 7<sup>35</sup> (Tarasenkova, Hlobin, Bogatyreva, Kolomiets & Serdiuk, 2015) and Geometry for grade 7<sup>36</sup> (Tarasenkova, Burda, Bogatyreva, Kolomiets & Serdiuk, 2015). It may be considered to be the beginning of practical stage of reforming school mathematical education in Ukraine on the basis of competence approach and gradual approximation of Ukrainian system of mathematical education to European and world standards.

It should be noted that in Ukrainian textbooks, the learning content associated with values and their properties is given exclusively inductively on examples using description, demonstration and characteristics. Other assumptions of the fundamentals of school Geometry course is also revealed inductively. In general, modern textbooks provide available learning content more fully; the ways of its presentation implement their correspondence to the age peculiarities of students more integral and may-sided.

**Conclusions.** The application of methods of comparative didactics of mathematics including those associated with its time (retrospective) vector allows to make a conclusion. The reform of school mathematical education of 60-s – 70-s of the XX centuries made fundamental changes to curricula, programs and textbooks in Mathematics of secondary school. Most changes have been preserved till now; some of them have been further developed. The content innovations of school course in Geometry of Kolmogorov’s reform time did not stand the test of time and are not appropriate nowadays.

<sup>28</sup>Tarasenkova, N.A., Bochko, O.P., Bogatyreva, I.M, Kolomiets, O.M., Serdiuk, Z.O. (2013). *Mathematics. Textbook for the 5th grade of the secondary school*. Kyiv: Publishing House "Osvita", 352 p. (in Ukr.).

<sup>29</sup>Tarasenkova, N.A., Bogatyreva, I.M, Kolomiets, O.M., Serdiuk, Z.O. (2014). *Mathematics. Textbook for the 6th grade of the secondary school*. Kyiv: Publishing House "Osvita", 304 p. (in Ukr.).

<sup>30</sup>Tarasenkova, N.A., Bogatyreva, I.M, Kolomiets, O.M., Serdiuk, Z.O. (2015). *Algebra. Textbook for the 7th grade of the secondary school*. Kyiv: Publishing House "Osvita", 304 p. (in Ukr.).

<sup>31</sup>Tarasenkova, N.A., Bogatyreva, I.M, Kolomiets, O.M., Serdiuk, Z.O. (2016). *Algebra. Textbook for the 8th grade of the secondary school*. Kyiv: UOVTS "Orion", 336 p. (in Ukr.).

<sup>32</sup>Burda, M.I., Tarasenkova, N.A., Bogatyreva, I.M, Kolomiets, O.M., Serdiuk, Z.O. (2013). *Geometry. Textbook for the 11th grade of the secondary school*. Kyiv: Publishing House "Osvita", 304 p. (in Ukr.).

<sup>33</sup>Tarasenkova, N.A., Bogatyreva, I.M, Kolomiets, O.M., Serdiuk, Z.O. (2015). *Test subject competences. Mathematics, 5th grade of the secondary school*. Collection of tasks for assessment of pupil achievements [Teach. method. guidances.]. Kyiv : «Orion», 48 p. (in Ukr.).

<sup>34</sup>Tarasenkova, N.A., Bogatyreva, I.M, Kolomiets, O.M., Serdiuk, Z.O. (2015). *Test subject competences. Mathematics, 6th grade of the secondary school*. Collection of tasks for assessment of pupil achievements [Teach. method. guidances.]. Kyiv : «Orion», 40 p. (in Ukr.).

<sup>35</sup>Tarasenkova, N.A., Bogatyreva, I.M, Globin, O.I., Kolomiets, O.M., Serdiuk, Z.O. (2015). *Test subject competences. Algebra, 7th grade of the secondary school*. Collection of tasks for assessment of pupil achievements [Teach. method. guidances.]. Kyiv : «Orion», 32 p. (in Ukr.).

<sup>36</sup>Tarasenkova, N.A., Burda, M.I., Bogatyreva, I.M, Kolomiets, O.M., Serdiuk, Z.O. (2015). *Test subject competences. Geometry, 7th grade of the secondary school*. Collection of tasks for assessment of pupil achievements [Teach. method. guidances.]. Kyiv : «Orion», 24 p. (in Ukr.).