

PRACTICE-ORIENTED TEACHING OF MATHEMATICS AS A CROSS LINE OF MODEL PROGRAMS FOR GRADE 5-6 OF THE NEW UKRAINIAN SCHOOL*

**VASYL O. SHVETS, SVITLANA M. LUKIANOVA,
TETIANA O. NASADIUK**

ABSTRACT: *The article examines model curricula in mathematics for students of the 5th-6th grades. The ideas of the authors regarding the new trends in the content of the 5th-6th grade mathematics course of the New Ukrainian School and the pedagogical technologies of its teaching are analyzed. Conclusions were made about the orientation of model mathematics curricula for grades 5-6 on strengthening the practical and applied direction of the school mathematics course, increasing attention to the formation and development of key competencies. The article emphasizes the importance of revealing inter-subject and intra-subject connections during the teaching of mathematics to 5-6 grade students.*

KEYWORDS: *practice-oriented teaching of mathematics, model curricula, competencies, interdisciplinary educational projects.*

2020 Math. Subject Classification: 97D30

Introduction

In the modern world, mathematical literacy has become a key to the success and economic development of the state, turning from a method of calculations into a universal language of science.

According to the results of the participation of Ukrainian schoolchildren in the international study PISA 2018, the Ukrainian Institute of the Future held a discussion among scientists, educators, entrepreneurs in search of answers to questions about the development and importance of mathematics education. The main theses of

*The article is partially supported by the project RD-08-146/02.03.2022 of the Bishop K. Preslavski University Research Fund for 2022.

scientists boil down to the fact that mathematics is a kind of gymnastics for the brain; a way of developing and training critical thinking, analytical skills and the ability to make constructive rational decisions based on data. In addition, mathematical literacy is the basis of the formation of scientific thinking (Skyba, 2021).

On the basis of research conducted on successful education systems in developed countries, experts of the Ukrainian Institute of the Future identified two key principles: orientation towards a deeper understanding by students of a smaller amount of information due to the advantage of the practical component over the theoretical one, and a support system for "weak" students (Skyba, 2021).

For example, in Swedish mathematics textbooks, a significant place is devoted to problems that have a practical or applied content. Such tasks are used to motivate the study of a new topic, to investigate the properties of new concepts, to derive rules and their assimilation, as well as to test the knowledge and skills of students on this topic. That is, learning takes place using the method of learning on tasks or learning through tasks (Lukianova, 2020).

In British schools, mathematics is strongly connected to real life, so the tasks in the textbooks are adapted to the demands of today: about dividing a pizza, building with LEGO bricks, currency conversion, budgeting, repair work, etc. In the USA, teachers are learning such an innovative teaching method as teaching through fascinating stories from life, the so-called "storytelling", according to which, instead of far-from-real-life examples from the textbook, the teacher introduces students to new material and formulates tasks for research in an exciting way. In Chinese schools, educational material is explained mainly in an interactive form. During the game, pupils master new material based on the close connection between disciplines and spheres of human activity. Students in Canada and Poland study mathematics using tasks whose presentation form is as close as possible to life (in the form of tables, graphs, schemes, plans, drawings); tasks for research, substantiation of own judgments and

results; tasks-experiments; tasks involving work in pairs and groups (Nasadiuk, 2020).

It is worth noting that a country's choice of a particular model of education is based on its cultural, historical and economic characteristics, which makes it impossible for other countries to blindly follow their successful experience.

Note that an important step towards the modernization of the education system in Ukraine is the development and adoption of the Concept for the Development of Science and Mathematics Education (STEM Education) (Verhovna Rada Ukrainy, 2020), according to which educational methods and STEM curricula should be aimed at the formation of key STEM skills that are relevant in the labor market competencies, such as: cognitive skills; information processing, data interpretation and analysis; problem solving and engineering thinking; scientific and research skills; algorithmic thinking and digital literacy; design thinking, creativity and innovation; manipulative and technological skills; collaboration and communication skills.

Therefore, it is natural and mathematical education that should become the key direction of the development of the educational field, which will meet the demands of the modern economy and the needs of society, which once again emphasizes the important role of mathematics in the modern world.

Results

The purpose and principles of the educational process in basic secondary education institutions are defined in the State Standard (MON Ukrainy, 2020), which gives a general description of the content of education, explains the requirements for mandatory learning outcomes and benchmarks for their assessment. International experts from the projects "New Ukrainian School - 2" (Poland), "Democratic School" of the Vergeland European Center (Norway), "Finnish Support for Ukrainian School Reform" (Finland) were involved in the development of the current State Standard. According to this document, teaching mathematics in the first cycle of basic

school performs a number of tasks that are significant for the overall development of the student's personality, in particular: formation of the ability to investigate problematic situations and identify problems that can be solved using mathematical methods; modeling processes and situations, developing strategies, action plans for solving problems; critical assessment of the processes and results of problem solving; development of mathematical thinking for knowledge and transformation of reality and development of mathematical speech.

On the basis of the State Standard of Basic Secondary Education and the Standard Educational Program for Grades 5-9 of General Secondary Education Institutions, in 2021, 7 Model Curriculums (MCP) for teaching mathematics were developed for students of grades 5-6, each of which indicates the expected learning outcomes, proposed content of educational material in mathematics and types of educational activities.

On the example of the analysis of several MCP-es, we will consider the ideas proposed by the authors regarding the study of the mathematics course in grades 5-6.

Among the developers of MCP (Merzliak et. al., 2021) there are well-known authors of textbooks and teaching aids in mathematics for grades 5-11 in Ukraine. They believe that more attention should be paid to building individual educational trajectories of students. To do this, they suggest involving students in project work. In addition, the program emphasizes the importance of implementing inter-subject and intra-subject connections, namely: content-informational, operational-activity and organizational-methodical. According to the authors (Merzliak et. al., 2021), their use increases the cognitive interest of schoolchildren in learning and raises the level of their general culture, creates conditions for the systematization of educational material and the formation of a scientific outlook. Schoolchildren gain experience in applying knowledge in practice and transferring it to new situations. The experience of mathematical activity is proposed to be applied in the study of subjects of other educational fields by: use by students during cognitive activity; mathematical modeling of the processes

being studied; solving problems with plots of other educational subjects in the course of mathematics; implementation of interdisciplinary educational projects, etc.

The content of MCP (Bedenko et. al., 2021) is focused on the formation of key competencies in students by solving problems for the analysis of specially methodically adapted modern real or perspective economic, ecological, transport, financial and other projects in the field of natural sciences, engineering and technology, environmental, innovative, information - communicative, civic-social, entrepreneurship and financial literacy, implemented or planned for implementation in different countries on different continents.

According to the authors of the program, the real practical orientation and dynamism of the problem material, not only in terms of subject matter, but also in terms of the methodology of setting (branched problems, problems with excess and lack of data, for solving in teams, etc.) should be the key difference between programs and textbooks of the new generation from previous more conservative options. To implement the applied orientation, the program offers such types of educational activities as: student project activities, group performance of practical tasks, work with Internet resources.

A feature of MCP [8] is interdisciplinary integrated modules that involve the use of individual and group forms of interaction: performance of individual tasks, student project activities, didactic games, tournaments, quizzes, quests, educational excursions, etc.

The authors of this MCP propose to pay considerable attention to the study of purely mathematical material as well as integration with other educational fields: informatics, natural sciences, technology, art, civics, health care, history, and others. In view of this, the program offers opportunities for the formation of students of both subject and other key competencies, which will involve an increase in the number of areas of application of mathematics in everyday life. According to the authors of the program, interdisciplinary connections in the teaching of mathematics are an important means of achieving the applied orientation of the study of mathematics. The mutual

penetration of knowledge and methods in various educational subjects has not only applied significance, but also creates favorable conditions for the formation of a scientific outlook.

Interesting is the proposal of the authors of MCP (Vasylyshyn et. al., 2021) regarding the study of integrated educational modules, such as: "History of origin natural numbers and writing numbers", "Application of mathematical knowledge in everyday life", "Mathematics in works of art", "Image of ordinary fractions in the graphic editor Paint", "Mathematics and the basics of a healthy lifestyle", "Mathematics in history", "Mathematics in the world of nature and art".

Among the types of educational activities proposed in this MCP in order to implement the provision of connections with related educational fields, the following can be named: performing the simplest financial calculations in everyday life; performance of an individual task or group work on an art project; organization of educational excursion; solving equations using application software (Wolfram Alpha, MathPapa, Photomath, etc.); conducting discussions, debates, round tables, preparing reports and projects; discussion of examples of mathematical discoveries, which influenced the development of technologies and contributed to the improvement of the quality of life people.

According to the authors of MCP (Burda & Vasylieva, 2021) a necessary condition for the formation of students' competencies is an activity approach to learning, which involves the constant inclusion of students in various types of pedagogically appropriate active educational and cognitive activities, as well as its practical orientation. That is why the developers (Burda & Vasylieva, 2021) pay considerable attention to practical, research and project work of various kinds. They also recommend expanding the range of applied problems, paying attention in lessons to construction and modeling, i.e. strengthening the practical orientation of learning, performing tasks on the extended reproduction of imaginary or real situations under the conditions of text problems, applying various types of

modeling of applied problems (verbal, schematic, tabular, graphic , sign-symbolic) and construction of the conditions of problems or situations based on the results of the analysis of given mathematical models.

The program states that the teaching of mathematics should provide for the orientation of the educational process to the formation in students of a system of universal, national, civic, personal and other values that determine the attitude of the younger generation to the world, to themselves, to their activities, etc. It is worth considering problems of valueological, ecological, financial-economic, national-patriotic content, etc. Compilation of such tasks by students is also useful.

Among the types of educational activities offered by the authors of this program, it is interesting to note: searching for information about the history of Sudoku and magic squares; creating puzzles with numbers or mathematical puzzles; study of product packaging for the presence of values; construction of geometric figures; finding and researching different types of geometric shapes on environments objects; finding and researching different types of scale on maps and plans; tasks of a research nature on the average value of a quantity; work with research data; search and critical analysis of data about the real world on the Internet; search for spheres of human activity in which whole and fractional numbers are used; research activity of data search of various types of quantities and their rounding; construction of diagrams in Excel depicting the daily schedule or diet student nutrition; the principle of operation of navigators. Developers suggest actively using interactive forms of work and ICT, in particular programming environments.

Conclusions

The analysis of considered above model training programs makes it possible to draw conclusions about their orientation towards the formation of key life competencies in students thanks to the use of the following forms and methods: "learning through practical

activities, conducting experiments"; "interdisciplinary integrated modules that involve the use of individual and group forms of interaction"; "shifting the emphasis from a purely frontal form of the educational process to group and individual project activities"; "real practical orientation and dynamism of the problem material"; "practical, research and project works of various types" etc. Thus, their common key feature is the applied focus of teaching mathematics, which is implemented in a practice-oriented approach to its organization.

Ability to recognize a problematic situation; formulate tasks for its solution; collect information from various sources; analyze information provided in different forms; draw up an algorithm of actions aimed at achieving a result; evaluate and interpret work results; to carry out self-analysis - critically important skills, the formation of which is the basis of work on practice-oriented tasks, the plots of which are descriptions of situations from the everyday life of students, oriented to the performance of certain practical actions using the mathematical knowledge available to students. The main goal of such tasks is the formation of students' abilities and skills necessary for the application of mathematics in everyday life, demonstrating the importance of mathematical knowledge in the life of every person and increasing the cognitive activity of students.

The use in the process of teaching mathematics to students of grades 5-6 of tasks that involve their own everyday experience (buying goods, saving, planning time), which require finding and processing information from various sources, presented in different forms, integrated tasks and such that give an idea of modern professions will allow providing pupils with, at a minimum, the necessary skills of a civilized person, needed for social interaction, and at the most, will ensure the formation of top skills of a successful personality in pupils, including: analytical thinking, innovation, critical thinking, strategic thinking, creativity etc. The success of such practice-oriented training depends on the presence of a comprehensive approach to its implementation, which consists in compliance with

certain methodological requirements, taking into account important psychological and pedagogical features and competent interaction of all participants in the educational process.

REFERENCES:

- [1] Bedenko M.V., Klochko I.Ia., Kordysh T.H., Tadeiev V.O. (2021). Modelna navchalna prohrama «Matematyka. 5-6 klasy» dlia zakladiv zahalnoi serednoi osvity [Model curriculum "Mathematics. 5-6 classes" for institutions of general secondary education]. Retrieved from <https://drive.google.com/file/d/1L9uwoxLYLij1-vN66n0bQ1NR702c4N37/view> [in Ukrainian].
- [2] Burda M.I., Vasylieva D.V. (2021). Modelna navchalna prohrama «Matematyka. 5-6 klasy» dlia zakladiv zahalnoi serednoi osvity [Model curriculum "Mathematics. 5-6 classes" for institutions of general secondary education]. Retrieved from <https://drive.google.com/file/d/1-SYSGA120JWNL-4qJdQhIltEam5j7h/view> [in Ukrainian].
- [3] Lukianova S.M. (2020). *Zarubizhnyi dosvid shkilnoi matematychnoi osvity ta realii vitchyznianoï praktyky (na prykladi osvity Shvetsii)* [Foreign experience of school mathematics education and the realities of domestic practice (on the example of education in Sweden)]. Problemy ta perspektyvy suchasnoi nauky ta osvity. Lvivskyi naukovyi forum: 31-33. Retrieved from <http://lviv-forum.inf.ua/save/2020/15-16.08.2020/%D0%97%D0%B1%D1%96%D1%80%D0%BD%D0%B8%D0%BA.pdf> [in Ukrainian].
- [4] Merzliak A.H., Nomirovskyi D.A., Pykhtar M.P., Rublov B.V., Semenov V.V., Yakir M.S. (2021). Modelna navchalna prohrama «Matematyka. 5-6 klasy» dlia zakladiv zahalnoi serednoi osvity [Model curriculum "Mathematics. 5-6 classes" for institutions of general secondary education]. Retrieved from https://drive.google.com/file/d/174eWhQpn_qib08MSK_0GGucbM5A_HZOHE/view [in Ukrainian].
- [5] MON Ukrainy. (2020). *Derzhavnyi standart bazovoi serednoi osvity* [State standard of basic secondary education]. Retrieved from

- <https://mon.gov.ua/ua/osvita/zagalna-serednya-osvita/nova-ukrayinska-shkola/derzhavnij-standart-bazovoyi-serednoyi-osviti> [in Ukrainian].
- [6] Nasadiuk T.O. (2020). *Bazovyi riven matematychnoi kompetentnosti uchniv yak zaporuka ekonomichnoho rozvytku derzhavy* [The basic level of students' mathematical competence as a guarantee of the economic development of the state]. *Problemy ta perspektyvy suchasnoi nauky ta osvity. Lvivskiyi naukovyi forum*: 35-37. Retrieved from <http://lviv-forum.inf.ua/save/2020/15-16.08.2020/%D0%97%D0%B1%D1%96%D1%80%D0%BD%D0%B8%D0%BA.pdf> [in Ukrainian].
- [7] Skyba M. (2021). *Yak uriatuvaty vykladannia matematyky v Ukraini* [How to save the teaching of mathematics in Ukraine]. Retrieved from <https://zn.ua/ukr/EDUCATION/jak-urjatuvati-vikladannja-matematiki-v-ukrajini.html> [in Ukrainian].
- [8] Verhovna Rada Ukrainy. (2020). *Kontseptsia rozvytku pryrodnycho-matematychnoi osvity* [Concept of development of science and mathematics education]. Retrieved from <https://zakon.rada.gov.ua/laws/show/960-2020-%D1%80#n8> [in Ukrainian].
- [9] Vasylyshyn M.S., Mylianyk A.I., Pratsovytyi M.V., Prostakova Yu.S., Shkolnyi O.V. (2021). *Modelna navchalna prohrama «Matematyka. 5-6 klasy» dlia zakladiv zahalnoi serednoi osvity* [Model curriculum "Mathematics. 5-6 classes" for institutions of general secondary education]. Retrieved from https://drive.google.com/file/d/1YMPwWKLNmdHTQ6wj4_5aUH0sPafkCBqX/view [in Ukrainian].

Vasyl Shvets

National Pedagogical Dragomanov University, Kyiv, Ukraine
vasylshvets@ukr.net
ORCID 0000-0003-2084-1336

Svitlana Lukianova

National Pedagogical Dragomanov University, Kyiv, Ukraine
s.m.lukyanova@npu.edu.ua

ORCID 0000-0001-8093-3211,

Tetiana Nasadiuk

National Pedagogical Dragomanov University, Kyiv, Ukraine

tatiana_nasaduk@ukr.net

ORCID 0000-0001-5222-0492

