

# Implementing the final stage of working with the planimetric problem while teaching as a means of improving geometry knowledge of schoolchildren

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

---

## Abstract

© 2018 by the authors. The issue under study is urgent today because there is a necessity for students to develop skills in working with the mathematical problem at the final stage of its solution in order to get excellent results while learning geometry and when encouraging intellectual and personal development. The aim of the research is to develop the theory and methodology of the final stage of working with planimetric problems as a means of improving the quality of geometry knowledge of schoolchildren. The key research method of the issue is match making between the components of the final stage of working with the mathematical problem and their corresponding operations. The research has resulted in defining the structure of the final stage of working with mathematical problems. It allowed to perform a certain set of operations composing the skill of working with the mathematical problem at the final stage of its solution. The article shows the technique for composing special tasks in order to form operations corresponding to the final stage of working with mathematical problems. It is proved that students' ability to carry out the above described stage of solving a mathematical problem helps them to get excellent results while learning geometry. The author's technique of teaching students to work with the mathematical problem at the final stage of its solution, proposed in the article, can be used by mathematical teachers in their practical work, by the authors of resource books for students and teachers and by students of pedagogical universities while doing their special courses.

<http://dx.doi.org/10.29333/ejmste/97829>

---

## Keywords

Final stage of working with the mathematical problem, Mathematical problem, Results of teaching geometry, System of tasks, Technique

## References

- [1] Akishina, E. M., Sudakova, Y. E., Prokopyev, A. I., Yakubenko, K. Y., Solovyeva, N. A., & Korzhuev, A. V. (2017). System of cultural experience development of humanities students in modern information media conditions. *Man in India*, 97(14), 115-127
- [2] Artemov, A. K. (1973). On heuristic methods for teaching geometry in school. *Mathematics in school*, 6, 25-29
- [3] Bahar, A., & Maker, C. J. (2015). Cognitive Backgrounds of Problem Solving: A Comparison of Open-ended vs. Closed Mathematics Problems. *EURASIA Journal of Mathematics, Science and Technology Education*, 11, 1531-1546

- [4] Baranova, E. V. (1999). Methodology of applying academic studies when teaching Geometry in middle school: PhD Thesis. Saransk: Mordovia State Pedagogical Institute named after M. E. Evsevev
- [5] Baranova, E. V. (2003). Special course of study «Academic studies in teaching Mathematics». Mathematical bulletin of pedagogical institutes and universities of Volga-Vyatka region: periodic inter-university collection of scientific and methodological papers, 7, 246-247
- [6] Bivic, N., Maricic, S. M., & Pikula, M. (2016). The effects of differentiation of content in problem-solving in learning geometry in secondary school EURASIA Journal of Mathematics, Science and Technology Education, 12(11), 2783-2795. <https://doi.org/10.12973/eurasia.2016.02304a>
- [7] Cherepanova, T. P. (1964). Teaching the variability of a problem statement is a means of stimulating mental activity of students. Mathematics in school, 5, 36-39
- [8] Collis, K. F., Watson, J. M., & Campbell, K. J. (1993). Cognitive functioning in mathematical problem solving during early adolescence Mathematics Education Research Journal, 5(2), 107-123. <https://doi.org/10.1007/BF03217190>
- [9] Czarnocha B., & Baker, W. (2016). The Creative Enterprise of Mathematics Teaching Research: Elements of Methodology and Practice. Rotterdam: Sense Publishers. <https://doi.org/10.1007/978-94-6300-549-4>
- [10] Demchenkova, N. A. (2000). Problem-searching tasks as a means of developing research skills in future mathematics teachers when learning Mathematics teaching techniques for pedagogical universities: PhD thesis. Saransk: Mordovia State Pedagogical Institute named after M. E. Evsevev
- [11] Domkina, G. V., & Lapteva, T. A. (1999). One problem involves all Plane Geometry. Mathematics, 40, 28-30
- [12] Evnin, A. Y. (2000). Studying a mathematical problem as a means of developing creative abilities of students: PhD Thesis. Chelyabinsk: Chelyabinsk State Pedagogical University
- [13] Galushkin, A. A. (2018). The use of information and communications technology to foster the competitiveness of the entrepreneurial organizations within the Education and Science sector. International Journal of Engineering and Technology (UAE), 7(3.14-Special Issue 14), 323-326
- [14] Georgiev, V. S. (1988). Experience of stimulating students' activity based on applying the cycles of problems. Mathematics in school, 1, 77-78
- [15] Goldman, A. M., & Zvavich, L. I. (1990). Academic series at mathematical lessons. Mathematics in school, 5, 19-22
- [16] Gotman, E. G. (1991). Variation of the problem about the square and its inscribed triangle. Mathematics in school, 1, 26-28
- [17] Gotman, E. G., & Skopets, Z. A. (2000). One problem-different solutions. Moscow: Prosveshcheniye
- [18] Grabar M. I., & Krasnyanskaya, K. A. (1977). Application of mathematical statistics in pedagogical research. Non-parametric methods. Moscow: Pedagogy
- [19] Gu, F., Huang, R., & Gu, L. (2017). Theory and Development of Teaching Through Variation in Mathematics in China. Teaching and Learning Mathematics through Variation, 2, 13-43. [https://doi.org/10.1007/978-94-63-0-782-5\\_2](https://doi.org/10.1007/978-94-63-0-782-5_2)
- [20] Gu, L., Huang, R., & Marton, F. (2004). Teaching with variation: A Chinese way of promoting effective mathematics learning. In L. Fan, N. Wong, J. Cai, & S. Li (Eds.). How Chinese learn mathematics: Perspectives from insiders. Mahwah: World Scientific, 309-347. [https://doi.org/10.1142/9789812562241\\_0012](https://doi.org/10.1142/9789812562241_0012)
- [21] Guba, S. G. (1972). Variability of proof problems as a means of stimulating mathematical activity in students and generating their interest in the subject (PhD Thesis). Yaroslavl: Yaroslavl State Pedagogical Institute
- [22] Henríquez-Rivas, C., & Montoya-Delgado, E. (2016). The Mathematical Work of Teachers in the Transition from the Synthetic Geometry to the Analytic at Secondary School Bolema, Rio Claro, 30(54), 45-66. <https://doi.org/10.1590/1980-4415v30n54a03>
- [23] Ivanova, T. A. (1992). Variability of mathematical problems as a means of developing intellectual abilities in students. Development of students when teaching and learning Mathematics: Inter-university collection of research papers. N. Novgorod: NSPU named after M. Gorky, 6-22
- [24] Ivanova, T. A., Perevoshchikova, E. N., Grigoryeva, T. P., & Kuznetsova, L. I. (2000). Theoretical basis for teaching Mathematics in middle school. N. Novgorod: NSPU
- [25] Izaak, D. F. (1983). Generalizations of geometrical problems. Mathematics in school, 2, 55-57
- [26] Izaak, D. F. (1987). Occurrence of new problems when studying geometrical problems. Mathematics in school, 6, 62-65
- [27] Kanin, E. S., & Nagibin, F. F. (1982). The final stage of solving mathematical problems. Moscow: Prosvesheniye
- [28] Karpushina, N. M. (2006). Dynamic problems in teaching geometry. Mathematics in school, 3, 48-54
- [29] Kolyagin, Y. M. (1977). Problems in teaching mathematics. Part I. Moscow: Prosveshcheniye
- [30] Kryukova, N. I., Zakharova, A. N., Dulina, G. S., Yusupova, Z. F., Belonovskaya, I. D., & Bogdanova, J. N. (2017). Didactic features of pedagogical interaction as the basis of university education. Man in India, 97(3), 29-41

- [31] Kuznetsova, L. I. (1992). Developing heuristic methods of mental activity in students when solving geometrical problems. Development of students when teaching and learning Mathematics: Inter-university collection of research papers. N. Novgorod: NSPU named after M. Gorky, 33-45
- [32] Kvon, G. M., Vaks, V. B., Masalimova, A. R., Kryukova, N. I., Rod, Y. S., Shagieva, R. V., & Khudzhatov, M. B. (2018). Risk in implementing new electronic management systems at universities. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(3), 891-902
- [33] Lester, F. K., & Cai, J. (2016) Can Mathematical Problem Solving Be Taught? Preliminary Answers from 30 Years of Research. *Posing and Solving Mathematical Problems. Research in Mathematics Education*. Cham: Springer
- [34] Likhota, E. A. (1983). Variability of problem statements at extra-curricular lessons. *Mathematics in school*, 6, 81-82
- [35] Melnik, N. S. (1986). On interconnected geometrical problems. *Mathematics in school*, 6, 48-50
- [36] Mostov, A. I., & Nakonechny, M. N. (1976). Solving geometrical problems in different ways. *Mathematics in school*, 5, 44-48
- [37] Mutavchi, E. P., Prokopyev, A. I., Kostyleva, G. V., Blinov, L. V., Fedorov, V. V., & Polichka, A. E. (2018). Scientific-methodical resource of student training and vocational motivation development in university. *Espacios*, 39(20), 15
- [38] Nedogarok, G. P. (1989). Composing geometrical problems by students as a means of generating and developing general problem solving skills (PhD Thesis). Moscow: Moscow State Pedagogical Institute
- [39] Olbinsky, I. B. (1998). Development of the problem. *Mathematics in school*, 2, 15-16
- [40] Olbinsky, I. B. (2002). Methodology of teaching high school students to reflexive studying mathematical problems (PhD Thesis). Moscow: Moscow Pedagogical State University
- [41] Pleskach, Y. A. (2014). Academic studies on Geometry as a factor of broadening learning experience in students. Achievements and prospects of Psychology and Pedagogics Collection of papers of the international research and practice conference. Ufa, Russia: Aeterna Publishing
- [42] Ponarin, Y. P. (1992). One problem-different solutions. *Mathematics in school*, 1, 15-16
- [43] Potapova, S. V., Danilova, I. Y., Prasolov, V. I., Makarova, E. V., & Kryukova, N. I. (2018). Mythological foundations of ontology. *XLinguae*, 11(2), 672-685. <https://doi.org/10.18355/XL.2018.11.02.53>
- [44] Poya, D. (1991). How to solve the problem. Lvov: Quantor
- [45] Prasolov, V. V. (1988). Several proofs of the theorem on the altitudes of the triangular. *Mathematics in school*, 1, 72-73
- [46] Roshchina, N. L. (1996). Solving problems in different ways is the first step to aesthetic perception of Geometry. *Mathematics in school*, 3, 17-19
- [47] Roshchina, N. L. (1998). Developing aesthetic sense of students when solving planimetric problems: PhD Thesis. Moscow: Moscow Pedagogical State University
- [48] Rukshin, S. E. (1981). Series problems in extra-curricular activity. *Mathematics in school*, 6, 62-63
- [49] *Russiyskaya Gazeta*. (2013). Development Concept of Mathematical Education in the Russian Federation. Retrieved from <http://www.rg.ru/2013/12/27/matematika-site-dok.html>
- [50] Sarantsev, G. I. (1995). Exercises in teaching mathematics. Moscow: Prosveshcheniye
- [51] Sarantsev, G. I. (2002). Methods of teaching mathematics in secondary schools. Moscow: Prosveshcheniye
- [52] Sarantsev, G. I. (2003). Aesthetic motivation in teaching Mathematics. Saransk: Mordovia State Pedagogical Institute named after M. E. Evsevev
- [53] Sarantsev, G. I., & Kalinkina, T. M. (1994). Methods of obtaining knowledge as a means of arranging geometrical problems. *Mathematics in school*, 6, 2-4
- [54] Semenov, E. E. (1995). Reflections on heuristics. *Mathematics in school*, 5, 39-43
- [55] Skrabich, S. N. (2005). Developing the skill of composing planimetric problems based on the stated task. *Educational Technologies*, 4, 74-78
- [56] Sullivan, P., & Clarke, D. (1992). Problem solving with conventional mathematics content: Responses of pupils to open mathematical tasks *Mathematics Education Research Journal*, 4(1), 42-60. <https://doi.org/10.1007/BF03217231>
- [57] Tokmazov, G. V. (1994). Dynamic problems. *Mathematics in school*, 5, 9-12
- [58] Tsukar, A. Y. (1982). Extra work on the problem. *Mathematics in school*, 1, 42-43
- [59] Yasinovy, E. A. (1974). Composing mathematical problems by students as a means of stimulating their cognitive activity (PhD Thesis). Yaroslavl: Yaroslavl State Pedagogical Institute
- [60] Yudina, N. A. (2011). Teaching Analogy to students at the final phase of solving planimetric problems: PhD Thesis. Volgograd: Volgograd State Socio-pedagogical University

- [61] Zelenina, H. A. (2003). Functions of the final stage of working with the problem. Problems of Mathematical Education and Culture: Collection of abstracts of International scientific conference. Tolyatti, Russia: TSU, 92-93
- [62] Zelenina, N. A. (1998). Creative activity of students in modern educational concepts. Humanization and humanitarization of mathematical education in the school and university: papers of all-Russia scientific conference. Saransk, Russia: Mordovia State Pedagogical Institute Press, 50-52
- [63] Zelenina, N. A. (2004). The final stage of solving geometric problems in the main school: PhD Thesis. Kirov: Vyatka State University of Humanities
- [64] Zelenina, N. A. (2005). The structure of the final stage of solving a mathematical problem. Mathematical bulletin of pedagogical institutes and universities of Volga-Vyatka region: periodic inter-university collection of scientific and methodological papers, 7, 205-214