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Implementation of Geogebra Courseware in Teaching the Concept of Mathematical Function

Abstract. The research is devoted to teaching one of the basic mathematical concepts – the function – in the secondary school. Regarded as the key instrument of mathematics and experimental modeling, the notion of function including its perception, interpretation and application have always been under the scrutiny of Russian and foreign scientists. The authors focus their attention on specificity of students' perception of the above concept, integrated in teaching process, and provide several examples of functions, applied in different spheres of everyday life, in order to develop students' operational skills and competences related to mathematical functions. All the interrelated aspects of teaching methods and practices are considered on the basis of activity approach and information technologies.

The paper recommends a series of particular exercises, based on the APOS theory (Action – Process – Object – Scheme), along with the Geogebra courseware to help students master their conceptual understanding of mathematical function, and its operational options in various mathematical contexts (e.g. calculating the roots, estimating the limits and derivatives, changing the parameters, solving practical problems, etc). The assignment samples demonstrate visibility of the courseware and effectiveness of its application in practical teaching.

Keywords: function, e-learning, activity approach, Geogebra mathematical courseware, APOS theory (Action – Process – Object – Scheme).

References

1. Gromova E. V., Safuanov I. S. Teaching of the concept of function at Comprehensive School with the use of computer technologies. *Vestnik MGPU. Series «Informatics and Informatization of Education».* [Bulleten of the MSPU. Seria «Computer and Information education»]. 2013. № 1. P. 91–98. (In Russian)

2. Mordkovich A. G. Algebra. 8-j kl. Ch. 1. [Algebra. 8th Grade. Part 1]. Moscow: Mnemozina, 2005. 223 p. (In Russian)

3. Piaget J. The psychogenesis of knowledge and its epistemological significance. *Massimo Piattelli-Palmarini (ed.), Language and Learning: The Debate Between Jean Piaget and Noam Chomsky. Harvard University Press*, 1980. P. 1–23. (In Russian)

4. Romashkova E. V. *Funkcii i grafiki v 8–11-h klassah.* [Functions and their Graphs in Grades 8–11]. Moscow: Ilexa, 2011. 171 p. (In Russian)

5. Shvarts A. Yu. Rol' chuvstvennyh predstavlenij v ovladenii matematicheskimi ponjatijami. [The role of sensual representations in the mastering mathematical concepts. Cand.diss.] Moscow: MGU, 2011. 36 p. (In Russian).

6. Dubinsky Ed. & Harel G. The Nature of the Process Conception of Function / G. Harel & Ed. Dubinsky (Eds.). *The Concept of Function: Aspects of Epistemology and Pedagog.* United States of America: Mathematical Association of America, 1992. P. 85–107. (Translated from English)

7. Dubinsky Ed. Reflective Abstraction and Mathematics Education. The Genetic Decomposition of Induction and Compactness / Ed. Dubinsky, P. Lewin. *The Journal of mathematical behavior.* 1986. № 5. P. 55–92. (Translated from English)

8. Dubinsky Ed. Reflective abstraction in advanced mathematical thinking. *Mathematics Education Library.* V. 11. 1991. P. 95–126.

9. Sfard A. Operational Origins of Mathematical Objects and the Quandary of Reification-The Case of Function / G. Harel & Ed. Dubinsky (Eds.). *The Concept of Function Aspects of Epistemology and Pedagogy.* United States of America: Mathematical Association of America. 1992. P. 59–85. (Translated from English)

10. Sierpinska A. On understanding the notion of function / G. Harel & Ed. Dubinsky (Eds.). *The Concept of Function: Aspects of Epistemology and Pedagogy.* United States of America: Mathematical Association of America, 1992. P. 25–58. (Translated from English)

11. Tall D. & Vinner S. Concept image and concept definition in mathematics, with special reference to limits and continuity. *Educational Studies in Mathematics.* V. 12. 1981. P. 151–169. (Translated from English)

12. Vinner S. & Dreyfus T. Images and definitions for the concept of function. *Journal for Research in Mathematics Education*. V. 20. 1989. P. 356–366. (Translated from English)