

THEORY OF TEACHING MATHEMATICS

Mathematical preparation of future undergraduate students.

supervisor: prof. RNDr. Jozef Doboš, CSc. (jozef.dobos@upjs.sk)

study form: full time

Annotation: The aim is analysis of mathematical preparation of secondary school pupils for university level mathematics with the aim to align the expectation of university lecturers with the possibilities of mathematical education at secondary schools. Development of proposals for the improvement of the status quo.

Literature:

Martin Gould, Edward Hurst: Bridging the Gap to University Mathematics, Springer-Verlag 2009. ISBN: 978-1-84800-289-0

Ľubica Havírová: Mathematical preparation of incoming university student, Proceedings from the XVth Slovak–Czech–Polish Mathematical School in Spišské Podhradie, Slovakia, 2008, 113-118.

Alan Sultan, Alice F. Artzt: The mathematics that every secondary school math teacher needs to know, 2011 Routledge, Taylor & Francis. ISBN 0-203-85753-4

Inquiry approaches to teaching functions.

supervisor: doc. RNDr. Stanislav Lukáč, PhD. (stanislav.lukac@upjs.sk)

study form: full time

Annotation: Applying inquiry approaches to teaching can support the improvement of the quality of mathematics and science education. Elementary functions belong to the basic topics in school mathematics. Misunderstanding of concepts and relationships associated with functions and their properties leads to various student mistakes and misconceptions. Inquiry approaches to teaching bring the potential for an inductive way of building knowledge and a better understanding of educational content. Research objectives: to explore and analyse the possibilities of using inquiry approaches to teaching functions; develop methodological and teaching materials based on the application of inquiry approaches to the teaching of functions; to test innovative teaching methods in mathematics teaching; to evaluate the effect of the proposed approaches on the development of understanding and students' inquiry skills.

References:

Banchi, H., Bell, R.: The many levels of inquiry. In Science and Children, č. 46, 2008.

2. Held, Ľ. A kol.: Výskumne ladená koncepcia prírodovedného vzdelávania. Pedagogická fakulta Trnavskej univerzity v Trnave, 2011.

3. Marshall, J., C.: Succeeding with inquiry in science and math classrooms. NSTApress, USA, 2008. 4. Tobey, Ch., R., Arline, C, B.: Uncovering Student Thinking about Mathematics in the Common Core. Corwin a Sage Company, 2014.

Mathematics Teachers' Specialized Knowledge in the Context of Teaching Algebra.

supervisor: doc. RNDr. Ingrid Semanišínová, PhD. (ingrid.semanisinova@upjs.sk)

study form: full time

Annotation: Research on developing mathematics teachers' specialized knowledge include several components that need to be addressed in teachers' education. The thesis will explore these knowledge components when teaching topics focused on the development of algebraic thinking. The development of algebraic thinking was chosen

because it shifts students' understanding of mathematics beyond the results of specific calculations and facilitates the expression of general mathematical relationships. For any teacher, it is a great didactic challenge to achieve a deep students' understanding of algebra, which is one of the basic goals of mathematics teaching. In the thesis, the results of research concerning the mathematics teachers' specialized knowledge in the context of teaching Algebra will be analyzed and, based on the literature and current research results, different ways of developing algebraic thinking and different approaches to teaching will be creatively elaborated. We will design activities for teachers' professional development concerning teaching Algebra, and explore the connections between selected components of mathematics teachers' specialized knowledge and their practice in school when teaching topics aimed at developing algebraic thinking.

References:

Booth J.L., McGinn K.M., Barbieri C., Young L.K. (2017) Misconceptions and Learning Algebra. In: Stewart S. (eds) *And the Rest is Just Algebra*. Springer, Cham. https://doi.org/10.1007/978-3-319-45053-7_4

Kajander A. (2018) Learning Algebra with Models and Reasoning. In: Kajander A., Holm J., Chernoff E. (eds) *Teaching and Learning Secondary School Mathematics. Advances in Mathematics Education*. Springer, Cham. https://doi.org/10.1007/978-3-319-92390-1_52

Kieran C. (2018) Teaching and Learning Algebraic Thinking with 5- to 12-Year-Olds. Springer, Cham. <https://doi.org/10.1007/978-3-319-68351-5>

Lau, W.W.F. (2021) Pre-service mathematics teachers' professional learning in a pedagogy course: Examining changes in beliefs and confidence in teaching algebra. *Math Ed Res J* 33, 223–239. <https://doi.org/10.1007/s13394-019-00285-y>

Inquiry based mathematics education as a mean of mathematical literacy development among students from socially disadvantaged environment.

supervisor: doc. RNDr. Ingrid Semanišínová, PhD. (ingrid.semanisinova@upjs.sk)

consultant: RNDr. Veronika Hubeňáková, PhD.

study form: full time

Annotation: Mathematical literacy is proving to be one of the important factors that influence an individual's career options. Inquiry based education is one of the teaching methods

that significantly helps to develop mathematical literacy. Therefore, it makes sense to address the question of whether and under what conditions the inquiry based mathematics education helps to develop the mathematical literacy of children from socially disadvantaged backgrounds who are more at risk of poverty and unemployment in the future than their peers. The thesis will theoretically address the topic of mathematical literacy with a focus on students from socially disadvantaged environment, will create (or adapt) a research tool to measure the mathematical literacy of lower secondary school students. Qualitatively and quantitatively, we will describe the development of mathematical literacy among students who will be regularly taught using the inquiry based education.

References:

Stathopoulou C. (2017) Once Upon a Time... The Gypsy Boy Turned 15 While Still in the First Grade. In: Rosa M., Shirley L., Gavarrete M., Alanguí W. (eds) *Ethnomathematics and its Diverse Approaches for Mathematics Education. ICME-13 Monographs*. Springer, Cham.

https://doi.org/10.1007/978-3-319-59220-6_5

Správy štúdií OECD PISA zamerané na matematickú gramotnosť

Švaříček, R., & Šedřová, K. et al. 2007. Kvalitativní výzkum v pedagogických vědách. Praha: Portál. ISBN 978-80-7367-313-0.

Gravemeijer, K., & Cobb, P. 2006. Design research from a learning design perspective. In J. van den Akker, K. Gravemeijer, S. McKenney, & N. Nieveen (Eds.), Educational design research: the design, development and evaluation of programs, processes and products (pp. 45–85). New York: Routledge

Mathematical modeling and methods of data analysis in teaching Internet of Things programming.

supervisor: doc. RNDr. Ľubomír Šnajder, PhD. (lubomir.snajder@upjs.sk)

study form: full time

Annotation: An integral part of the emerging Industry 4.0 is the Internet of Things (IoT), which is a set of physical devices with sensors and actuators that are interconnected and share data over the Internet and other networks. Nowadays available IoT learning kits (eg BBC micro: bit with extensions) allow high school pupils to develop IoT applications such as smart city/car/home, health, or sports assistant. During IoT project development, it is necessary to use mathematical modeling of real phenomena and systems and apply various methods of data analysis in evaluating data collected from sensors, searching for specific data patterns, critical values, and their exploit in adapting/regulating/automating of the whole system. The main focus of the dissertation is to explore the development of IoT applications in non-formal and formal education and to develop teaching methodologies at secondary school mathematics and computer science subjects using mathematical modeling and selected methods of data analysis. The recommended methodological framework is design-based research.