

THEORY OF TEACHING MATHEMATICS

Mathematical preparation of future undergraduate students

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study form: full time

Annotation: 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.

Inquiry-based approaches to teaching functions.

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

study form: full time

Annotation: Nowadays, we can observe efforts to apply inquiry approaches to mathematics and science education. Elementary functions belong to the basic topics of school mathematics. Misunderstanding of concepts and relationships associated with functions and their properties leads to various students' mistakes and misconceptions. Inquiry approaches to teaching have the potential for inductive way of building knowledge and understanding of educational content. The research aims: analysis of the possibilities to implement inquiry approaches to teaching functions in high school; development of teaching and learning materials based on the application of inquiry approaches to teaching functions; examining innovative teaching and learning materials in mathematics teaching and evaluation of the effect of the designed approaches on the development of students' inquiry skills.

The influence of the problem-solving approach on the development of critical thinking and students' argumentation skills in the mathematics teaching

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

study form: full time

Annotation: The problem-solving approach is one of the ways supporting active learning. The application of the problem-solving approach to teaching is based on the learning activities enabling finding new practices and acquiring new concepts and relationships in solving problem. Appropriate use of the problem-solving approach to mathematics teaching should contribute to the development of critical thinking represented by the abilities to analyse and evaluate information about the problem, evaluate the significance of new ideas in the context of the solving the problem, assess different approaches to solving the problem and critically re-evaluate them from several aspects. The student should be able to explain and argue their problem-solving process using appropriate logical arguments derived from previously acquired knowledge. Argumentation is the process of forming reasons and drawing conclusions when discussing the correctness, effectiveness, and usability of a proposed problem-solving procedure. Research goals: to select suitable problem tasks and to develop methodological and teaching materials for the application of the problem-solving approach to the teaching of selected mathematical topics; quantitatively and qualitatively evaluate the impact of the proposed teaching and learning materials on the development of critical thinking and students' argumentation skills.

Mathematical modeling and methods of data analysis in teaching

Internet of Things programming

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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.

Development of metacognitive abilities of pupils in solving problems (D, E)

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study form: full time

Annotation: The basis for the development of pupils' metacognitive abilities is the analysis of mathematical problems according to different levels of cognitive difficulty in their solution. From the point of view of the teacher's management role in developing the metacognitive ability of pupils, it is important except for use tools of formative assesment to create „pre-problem" - to reformulate, modify the problem to the simpler, which leads the pupils to solve the original problem and the "post-problem" - to reformulate, respectively. create a new problem that builds on the original problem and extends the student's knowledge. Qualitatively oriented research will focus on the analysis of selection, creation, and awareness of problem-solving processes.