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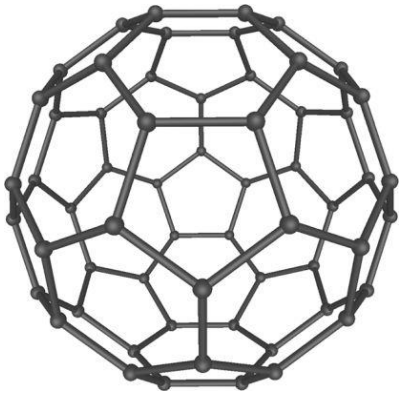

XXXVIIITH DIDMATTECH 2025

New methods and technologies in education research and practice

ABSTRACTS

2025

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ISBN 978-80-568-0797-2
EAN 9788056807972

The aim of the conference

The aim of the scientific professional conference XXXVIIIth DIDMATTECH 2025 is to introduce the latest findings from the field of the science of materials and technologies, including educational, information and communication technologies, and enable the participants to present the results of their own scientific research and professional activities with a special focus on the didactical aspects of education.

The conference was designed mainly for teachers who teach subjects in the area of technologies, informatics, mathematics, physics, electronics, sciences and others at different schools and use modern digital technologies, ICT and artificial intelligence in education, also for doctoral, postgraduate, and for talented students.

XXXVIII. DidMatTech 2025

3. – 4. December 2025

Program of Conference

Wednesday, 3rd of December:

09:30 – 09:55 Registration (on-line connection veryfication)
10:00 – 10:30 Welcome Speech; Open Ceremony
10:30 – 12:30 Plenary Session
12:30 – 13:30 Lunch Break
13:30 – 17:30 Oral and on-line presentations in sections

Thursday, 4th of December:

09:00 – 12:00 Oral and on-line presentations in sections
12:00 – 13:00 Lunch Break
13:30 – 16:00 Oral and on-line presentations in sections
16:00 – 16:30 Closing Session

Submitted papers and presentations

1. Ondrej Takáč, Kocsis Gergely: Possibilities of Close-up Photogrammetry in the Protection of Regional Cultural Heritage (plenary presentation – invited speakers) UJS FEI Komárno, SK
2. Péter Antal: The New Challenges of Digital Education in Practice – A digitális oktatás új kihívásai a gyakorlatban (plenary presentation – invited speaker) EKCU, Eger, HU
3. Júlia Šebejová, Jana Burgerová: Design of a Multi-Role AI Chatbot Framework for Supporting Project-Based Learning in Primary Education – Návrh rámca multi-rolového AI chatbota na podporu projektového učenia v primárnom vzdelávaní, PU – Prešov, SK
4. Norbert Annuš, Tibor Kmeť: Overview of Artificial Intelligence Applications in the Field of Personalized Education – Mesterséges intelligencia alkalmazások lehetőségeinek áttekintése a személyre szabott oktatás területén. (invited speakers) UJS FEI Komárno, SK
5. Krisztina Czakóová: Artificial intelligence in application development – Mesterséges intelligencia az alkalmazásfejlesztésben NP? (invited speaker). (UJS FEI Komárno, SK)
6. Csilla Prantner: Innovative Design of Digital Interfaces for Learning Support – Tanulást támogató digitális felületek innovatív tervezése, HEO, Budapest, HU
7. Natalia Shumeiko: How has AI Made a Transformation in the Education Sphere? (invited speaker), EU Bratislava, SK
8. Erik Tűri, Győző Horváth: Use of Web Technologies in Informatics Education (invited speakers) FI ELTE, Budapest, HU
9. Andor Abonyi-Tóth, Gaál Bence: Experience-Based Informatics with micro:bits – From Wandering Kits to Hungary's First National micro:bit Programming Competition (invited speakers) FI ELTE, Budapest, HU
10. Péter Bernát, Gábor Törley: Methods for Solving Task Types Using Spreadsheet and Programming (invited speakers). FI ELTE, Budapest, HU
11. Pavlína Částková, Michal Mrázek: Self-assessment of Pupils' Creative Skills in Technical Activities – Pilot Study FE PU, Olomouc, CZ

12. Miroslava Cimermanová: How Multimedia Content Shapes Learning Performance in E-learning: A Comparison of Results before and after its Implementation. PU, Prešov, SK
13. Gyöngyi Bújdosó, Deddy Gusman, Klára Czimre, Ernő Molnár, János Kapusi, Peter Czomba, Bence Balint Juhasz, Cornelia Mihaela Novac, Ovidiu Constantin Novac, Károly Teperics: Disruptive Technologies in Geography Education – Virtual Reality. KECU, Eger, HU
14. Piroska Biró, Tamás Kádek: Task Annotation Features in the ProgCont System., UD, Debrecen, HU
15. Zsuzsanna Szalayné Tahy, Győző Horváth: Specification of Extreme Value Type Tasks Specification – Szélsőérték típusfeladatok specifikációjának specifikációja (invited speakers) ELTE, Budapest, HU
16. Veronika Stoffová: Visualization of Algorithms Using the Array Data Structure – Vizualizácia algoritmov používajúcich údajovú štruktúru pole.TU, Trnava, SK
17. Noémi Bernadett Agócs: Game Development-Based Learning in an Introductory Programming Course, ELTE, Budapest, HU
18. Dávid Demeter, Ladislav Végh: Automatic Feedback in Programming Education : A Comprehensive Review. (invited speakers). (UJS FEI Komárno, SK)
19. Simona Kumpanová, Milan Štrbo: Computer Graphics and its Teaching : Practical Textbook, Exercise Book and Video Tutorials (plenary presentation – invited speakers) TU, Trnava, SK.
20. Jana Fialová: Blended Learning in Teaching Mathematics. TU, Trnava, SK
21. Jana Fialová – Roman Horváth: Developing Computer Literacy Among Primary School Pupils. TU, Trnava, SK
22. Péter Bernát: Didactic Advantages of Turtle Graphics in Scratch – Analysis and Case Study,. ELTE, Budapest, HU
23. Ildikó Pšenáková: The effectiveness of the flipped classroom model in education. TU, Trnava, SK
24. Milan Štrbo: Students Cheating During Online Testing TU, Trnava, SK
25. Veronika Gabaľová, József Udvaros, Jarmila Peldová, Mária Fáberová: Possibilities of Using Artificial Intelligence in Education : Innovative

Approaches with a focus on DIGIEDUHACK Bratislava – Možnosti využitia umelej inteligencie vo vzdelávaní : Inovatívne prístupy so zameraním na DIGIEDUHACK Bratislava. TU, Trnava, SK

26. Hana Hyksová: In-service training courses to increase teachers' competencies in the field of educational robotics – Doškoľovacie kurzy na zvýšenia kompetencií učiteľov v oblasti edukačnej robotiky. PU, Olomouc, SK
27. Jana Jakubčinová, Michal Virág, Michaela Kóňová, Inovácie vo vzdelávaní: implementácia nových trendov z pohľadu mladej generácie – Innovations in education: implementation of new trends from the perspective of the young generation, UKF, Nitra, SK
28. Miroslav Chráska: Future Teachers and Their use of Online Technologies – Budoucí učitelé a jejich způsob využití on-line technologií. PU, Olomouc, CZ
29. Ján Šorman, Michaela Antalová, Agnieszka Kania: Analytické metódy pri charakterizácii povrchových vôd vo vzdelávaní – Analytical methods in surface water characterization in education. UKF, Nitra, SK - UNEC, Krakow, PL
30. Ján Ondruška, Igor Štubňa, Štefan Csáki: Školský dilatometer – kalibrácia – School dilatometer – calibration, UKF, Nitra, SK

Content – Obsah

THE NEW CHALLENGES OF DIGITAL EDUCATION IN PRACTICE

Péter ANTAL, HU

Abstract: The active, creative pedagogical use of digital tools and the digital environment has become an important measure of professional flexibility in the teaching profession. The methodological innovation of digital education is a major contributor to many pedagogical successes, but it is important to be clear about the pedagogical goals that digital tools are intended and capable of achieving.

The experience of the last few years, especially in the Covid period, has shown the personal, technological, methodological and attitudinal shortcomings that have highlighted the anomalies of digital education. One of these real problems is that the content management and learning tracking systems used by teachers are not uniform even across school staff, and in many cases, there is a lack of creative communication between teachers.

The question is, whether we can really increase efficiency, i.e. whether the technology and methodology used can deliver the greatest pedagogical 'yield' with the least investment of time and energy.

This requires, however, an examination of the real picture in terms of methods, programmes and infrastructure.

The latest technologies, such as artificial intelligence, raise further opportunities and problems. On the opportunities side, in the education sector, they offer innovative solutions for improving teaching and learning processes through personalized learning, adaptive learning, or even intelligent tutors, incorporating a wide range of new tools and techniques. However, the use and introduction of artificial intelligence in education also clearly have ethical, professional, and methodological downsides. Although the advantages and opportunities mentioned above may bring positive benefits to the entire spectrum of education, we are not yet adequately prepared for their widespread, constructive, and methodologically well-founded implementation.

The primary issue regarding the use of artificial intelligence in schools is its impact on human factors. In Hungary, the majority of teaching staff are typically over 40, and they do not always identify with the use of new technological innovations and are not prepared for rapid changes. Another problem is that machine intelligence cannot support education comprehensively; many ethical and scientific-critical questions arise during its

use. Considering the mixed effects of artificial intelligence on education, in the long term it may result in the abandonment of general human thinking and logic.

In my presentation, I will explore these issues and present the results and conclusions of a survey of teachers.

Keywords: digital education, methodology, digital transition, artifical intelligence

A DIGITÁLIS OKTATÁS ÚJ KIHÍVÁSAI A GYAKORLATBAN

Absztrakt: A digitális eszközök és a digitális környezet aktív, kreatív pedagógiai alkalmazása mára a pedagógus pálya szakmai rugalmasságának egyik fontos fokmérőjévé vált. A digitális oktatás módszertani megújulása nagymértékben hozzájárul számos pedagógiai siker eléréséhez, azonban nem árt tisztázni, hogy a digitális eszközök segítségével milyen pedagógiai célokat kívánunk és tudunk elérni. Az utóbbi néhány év tapasztalatai, különösen a Covid időszak, megmutatták azokat a személyi, technológiai, módszertani és szemléletbeli hiányosságokat, melyek rámutattak a digitális oktatás anomáliáira. Egyik ilyen valós probléma, hogy a pedagógusok által használt tartalomkezelő és tanuláskövető rendszerek még az egyes iskolai tantestületek esetében sem egységesek, sok esetben hiányzik a tanárok közötti alkotó kommunikáció. A kérdés: valóban tudjuk-e növelni a hatékonyságot, vagyis az alkalmazott technológia és módszertan a lehető legkisebb idő- és energiabefektetéssel képes-e a legnagyobb pedagógiai „hozamot" eredményezni. Ehhez azonban szükség van a reális kép vizsgálatára, a módszerek, az alkalmazott programok, és az infrastruktúra szempontjából.

A legújabb technológiák pedig, mint a mesterséges intelligencia további lehetőségeket és problémákat vetnek fel. A lehetőség oldalon, az oktatási szektorban, innovatív megoldásokat kínál a tanítási és tanulási folyamatok javítására, a személyre szabott tanulás, az adaptív tanulás, vagy akár az intelligens tutorok, alkalmazásával, amely számos új eszközt és technikát foglal magában. A mesterséges intelligencia oktatásban történő használatának és bevezetésének láthatóan vannak etikai és szakmai, módszertani árnyoldalai is. Amellett, hogy a fent említett előnyök, lehetőségek, pozitív előnyökkel járhatnak az oktatás teljes spektrumára, ezek tömeges, és konstruktív, módszertanilag megalapozott bevezetésére még nem készültünk fel megfelelően.

Az elsődleges probléma a mesterséges intelligencia iskolai alkalmazásának, az emberi tényezőkre tett hatása. Magyarországon jellemzően 40 év feletti a

tantestületek többsége, akik nem minden esetben azonosulnak az új technológiai vívmányok használatával, és nincsenek felkészülve a gyors gyors változásokra. A másik probléma, hogy magát az oktatást a gépi intelligencia nem tudja mindenre kiterjedően segíteni, sok etikai és tudománykritikai kérdés merül fel használatuk során. A mesterséges intelligencia oktatásra tett vegyes hatásait tekintve pedig, hosszútávon az általános emberi gondolkodás, logika elhagyását eredményezheti.

Ezek közoktatási bevezetése még illuzórikusnak tekinthető különösen Magyarország vonatkozásában, hiszen rendszerszerűn még nem jelentek meg, bár sok alkalmazás már működőképes modellt mutathat.

Előadásunkban a fenti kérdéseket körbejárva, egy a pedagógusok körében végzett vizsgálat eredményeit és következtetéseit mutatom be.

Kulcsszavak: digitális oktatás, módszertan, digitális átállás, mesterséges intelligencia

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POSSIBILITIES OF CLOSE-UP PHOTOGRAMMETRY IN THE PROTECTION OF REGIONAL CULTURAL HERITAGE

Ondrej TAKÁČ, Gergely KOCSIS, SK

Abstract: The article provides an overview of the potential of detailed photogrammetry for the documentation and preservation of regional cultural heritage. Photogrammetry (now supported by affordable hardware, mobile applications, drones and advanced software) offers a non-invasive method for creating accurate and detailed 3D models of architectural monuments, sacred buildings, museum artifacts and elements of natural or sculptural heritage. Our paper presents a complete workflow, from image acquisition and optimal photographic conditions to point cloud generation and textured model reconstruction. Through several case studies – such as close-up modeling of sculptures, tree trunks and small outdoor artifacts – the paper highlights the strengths, weaknesses and limitations of this method. Comparative examples demonstrate how image quantity and quality affect the output, modeling accuracy and processing time. A review of current photogrammetric software (Pix4Dmapper, Agisoft Metashape, Meshroom, COLMAP, Kiri Engine and others) further highlights the wide range of tools available – from professional systems to affordable open source solutions. Detailed photogrammetry can significantly contribute to the protection of cultural heritage by enabling detailed documentation, condition assessment, digital archiving and public presentation, thus preserving fragile and irreplaceable objects for future generations.Článok poskytuje prehľad potenciálu detailnej fotogrametrie pre dokumentáciu a zachovanie regionálneho kultúrneho dedičstva. Fotogrametria (dnes podporovaná dostupným hardvérom, mobilnými aplikáciami, dronmi a pokročilým softvérom) ponúka neinvazívnu metódu na vytváranie presných a detailných 3D modelov architektonických pamiatok, sakrálnych budov, múzejných artefaktov a prvkov prírodného alebo sochárskeho dedičstva. Náš príspevok predstavuje kompletný pracovný postup, od získavania obrazu a optimálnych fotografických podmienok až po generovanie mračna bodov a rekonštrukciu textúrovaného modelu. Prostredníctvom niekoľkých prípadových štúdií – ako je napríklad modelovanie sôch, kmeňov stromov a malých vonkajších artefaktov zblízka – príspevok zdôrazňuje silné aj slabé stránky aj obmedzenia tejto metódy. Porovnávacie príklady demonštrujú, ako množstvo a kvalita obrazu ovplyvňujú výstup, presnosť modelovania a čas spracovania. Prehľad súčasného fotogrametrického softvéru (Pix4Dmapper,

Agisoft Metashape, Meshroom, COLMAP, Kiri Engine a ďalšie) ďalej zdôrazňuje široké spektrum dostupných nástrojov – od profesionálnych systémov až po dostupné riešenia s otvoreným zdrojovým kódom. Detailná fotogrametria môže významne prispieť k ochrane kultúrneho dedičstva tým, že umožňuje podrobnú dokumentáciu, posúdenie stavu, digitálnu archiváciu a verejnú prezentáciu, čím sa zachovávajú krehké a nenahraditeľné objekty pre budúce generácie.

Keywords: close-range photogrammetry, digital heritage, 3D modelling, documentation of monuments, regional heritage.

MOŽNOSTI BLÍZKEJ FOTOGRAMETRIE PRI OCHRANE REGIONÁLNEHO KULTÚRNEHO DEDIČSTVA

Abstrakt: Článok poskytuje prehľad potenciálu detailnej fotogrametrie pre dokumentáciu a zachovanie regionálneho kultúrneho dedičstva. Fotogrametria (dnes podporovaná dostupným hardvérom, mobilnými aplikáciami, dronmi a pokročilým softvérom) ponúka neinvazívnu metódu na vytváranie presných a detailných 3D modelov architektonických pamiatok, sakrálnych budov, múzejných artefaktov a prvkov prírodného alebo sochárskeho dedičstva. Náš príspevok predstavuje kompletný pracovný postup, od získavania obrazu a optimálnych fotografických podmienok až po generovanie mračna bodov a rekonštrukciu textúrovaného modelu. Prostredníctvom niekoľkých prípadových štúdií – ako je napríklad modelovanie sôch, kmeňov stromov a malých vonkajších artefaktov zblízka – príspevok zdôrazňuje silné aj slabé stránky aj obmedzenia tejto metódy. Porovnávacie príklady demonštrujú, ako množstvo a kvalita obrazu ovplyvňujú výstup, presnosť modelovania a čas spracovania. Prehľad súčasného fotogrametrického softvéru (Pix4Dmapper, Agisoft Metashape, Meshroom, COLMAP, Kiri Engine a ďalšie) ďalej zdôrazňuje široké spektrum dostupných nástrojov – od profesionálnych systémov až po dostupné riešenia s otvoreným zdrojovým kódom. Detailná fotogrametria môže významne prispieť k ochrane kultúrneho dedičstva tým, že umožňuje podrobnú dokumentáciu, posúdenie stavu, digitálnu archiváciu a verejnú prezentáciu, čím sa zachovávajú krehké a nenahraditeľné objekty pre budúce generácie.

Kľúčové slová: fotogrametria zblízka, digitálne dedičstvo, 3D modelovanie, dokumentácia pamiatok, regionálne dedičstvo.

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DESIGN OF A MULTI-ROLE AI CHATBOT FRAMEWORK FOR SUPPORTING PROJECT-BASED LEARNING IN PRIMARY EDUCATION

Júlia ŠEBEJOVÁ, Jana BURGEROVÁ, SK

Abstract: The digital transformation of primary education introduces new demands for supporting teachers, pupils, and parents. Current technologies based on large language models (LLMs) offer significant potential to enhance lesson planning, project-based learning, and school–family communication. However, most existing AI tools are designed for a single user role—typically the student—and lack an integrated ecosystem that connects all key educational actors. Moreover, in the Slovak context, no localized, pedagogically grounded AI model tailored for younger learners is currently available.

This paper presents a **concept of a multi-role AI chatbot** designed for primary education, integrating the three fundamental roles of the school ecosystem: **teacher, student, and parent**. The architecture is based on a layered model consisting of Natural Language Processing, Logic & Role Management, LLM components, and links to school information systems (Microsoft Teams, EduPage, School Information System, local databases). The model enables reciprocal enrichment of data and interactions: teacher-generated materials are transformed into child-friendly versions, student interactions support differentiation and formative assessment, and parents receive personalized explanations and recommendations based on both teacher input and student activity.

The **research gap** identifies three major deficiencies in current literature: (1) limited research on AI in primary education, (2) the absence of multi-role AI ecosystems serving teachers, students, and parents simultaneously, and (3) a lack of Slovak, curriculum-aligned AI tools appropriate for young learners. The proposed concept addresses these gaps by integrating technological, pedagogical, and communicative dimensions into a single ecosystem, providing a basis for future empirical evaluation.

The **methodological framework** builds on a mixed-methods design combining classroom observations, interaction analysis, semi-structured interviews with teachers, pupils, and parents, and pre–post comparisons. These methods will examine the impact of the chatbot on (1) pupils' autonomy in project-based learning, (2) the reduction of teacher workload, (3) the quality of project outputs and ICT competence development, and (4) the effectiveness of school–parent communication.

Prof. Ing. Jana Burgerová, PhD., contributed significantly to the pedagogical grounding of the model, ensuring coherence with digital pedagogy, ICT integration, and current trends in innovative teaching practices.

This conceptual study forms the foundation for the development of a Slovak multi-role AI chatbot and outlines future work focusing on technical implementation, pilot testing in Grades 1–4, longitudinal evaluation, and the development of the first Slovak child-adaptive language model compatible with primary-school needs.

Keywords: artificial intelligence, primary education, project-based learning, multi-role chatbot, educational ecosystem, large language models (LLM), digital transformation of schools.

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MESTERSÉGES INTELLIGENCIA ALKALMAZÁSOK LEHETŐSÉGEINEK ÁTTEKINTÉSE A SZEMÉLYRE SZABOTT OKTATÁS TERÜLETÉN

Norbert ANNUŠ, Tibor KMEŤ, SK

Absztrakt: A mesterséges intelligencia térnyerése az oktatásban új lehetőségeket teremt a személyre szabott tanulás megvalósítására. A tanulmány célja, hogy áttekintse azokat az mesterséges intelligencia-alapú alkalmazásokat, amelyek bizonyítottan támogatják az egyéni tanulási útvonalak kialakítását, és empirikus eredményekkel igazolt hatékonysággal rendelkeznek. A vizsgálat során olyan rendszerek kerültek kiválasztásra, amelyek adaptív algoritmusokkal dolgoznak, valós idejű diagnosztikai visszajelzést nyújtanak, és független kutatásokban is értékelésre kerültek. A vizsgálatok alapján ezek a rendszerek hozzájárulhatnak a tanulói teljesítmény javításához, a motiváció növeléséhez és a fejlődési útvonalak pontosabb nyomon követéséhez, ugyanakkor használatuknak technológiai és pedagógiai korlátai is vannak. A tanulmány rámutat, hogy a mesterséges intelligencia nem helyettesíti, hanem átalakítja a pedagógus szerepét.

Kulcsszavak: mesterséges intelligencia, személyre szabott oktatás, adaptív tanulási rendszerek, MI-alapú oktatási alkalmazások.

OVERVIEW OF ARTIFICIAL INTELLIGENCE APPLICATIONS IN THE FIELD OF PERSONALIZED EDUCATION

Abstract: The rapid expansion of artificial intelligence in education is creating new opportunities for the implementation of personalized learning. The aim of this study is to review those AI-based educational applications that demonstrably support the development of individualized learning pathways and whose effectiveness has been validated through empirical research. The analysis focuses on systems that employ adaptive algorithms, provide real-time diagnostic feedback, and have been evaluated in independent studies. Findings indicate that these systems can contribute to improved learner performance, increased motivation, and more accurate monitoring of learning progress, although their use also presents technological and pedagogical limitations. The study highlights that artificial intelligence does not replace teachers, but rather transforms their role within the learning process.

Keywords: artificial intelligence, personalized education, adaptive learning systems, AI-based educational applications.

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MESTERSÉGES INTELLIGENCIA AZ ALKALMAZÁSFEJLESZTÉSBEN

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Absztrakt: A mesterséges intelligencia (MI) alkalmazásfejlesztésben betöltött szerepe az elmúlt években jelentősen megnőtt, különösen az oktatási rendszerek digitális átalakulásának köszönhetően. Az MI-alapú technológiák lehetővé teszik olyan alkalmazások létrehozását, amelyek hatékonyan támogatják a tanárok és tanulók mindennapi munkáját, rugalmasan illeszthetők különböző oktatási környezetekbe. A fejlett nyelvi modellek képesek feldolgozni a feltöltött tananyagokat, és ezek alapján automatikusan vizsgakérdéseket, kvízeket vagy gyakorló feladatokat generálni. Ezen rendszerek fejlesztése során a természetesnyelv-feldolgozás kulcsszerepet játszik a tartalmak elemzésében és az értelmezhető feladatsorok előállításában. A tanulás hatékonysága így jelentősen növelhető, miközben az oktatók terhelése csökken. A fejlesztési folyamat során kiemelt szerepe van a megfelelő adatszerkezet kialakításának és a modellek finomhangolásának. A tanulmány egy digitális tananyagmegosztó alkalmazás fejlesztését mutatja be, a tananyag-alapú tesztgenerálásra fókuszálva. Ennek eredményeként a mesterséges intelligencia nem csupán technológiai újítás, hanem stratégiai eszköz az oktatás jövőjének formálásában, valamint kulcsfontosságú lépést jelent a személyre szabott oktatás felé vezető úton.

Kulcsszavak: mesterséges intelligencia, alkalmazásfejlesztés, szakdolgozatok, programozás, szoftvertervezés.

ARTIFICIAL INTELLIGENCE IN APPLICATION DEVELOPMENT

Abstract: The role of artificial intelligence (AI) in application development has increased significantly in recent years, especially due to the digital transformation of educational systems. AI-based technologies enable the creation of applications that effectively support the daily work of teachers and learners, while being flexibly adaptable to various educational environments. Advanced language models can process uploaded learning materials and automatically generate exam questions, quizzes, or practice tasks based on them. During the development of such systems, natural language processing plays a key role in analysing content and producing interpretable task sets. As a result, learning efficiency can be greatly improved while reducing the

workload of educators. In the development process, particular emphasis is placed on designing appropriate data structures and fine-tuning the models. This study presents the development of a digital learning-material-sharing application, focusing on learning-material-based test generation. Consequently, artificial intelligence is not only a technological innovation but also a strategic tool in shaping the future of education, representing a key step toward personalized learning.

Keywords: artificial intelligence, application development, thesis works, programming, software design.

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INNOVATIVE DESIGN OF DIGITAL INTERFACES FOR LEARNING SUPPORT

Csilla PRANTNER, HU

Abstract: Rapid technological development has led to significant changes not only in the economic, cultural and social areas, in the processes of human communication, but also in education. In recent years, human-machine interaction has undergone a significant transformation, which was marked by free access to generative artificial intelligence systems. Subsequently, there has been a rapid spread of applications with built-in artificial intelligence. This development is increasingly described as an indicator of the onset of the "fifth industrial revolution" (Prantner, 2025). Artificial intelligence is increasingly used in various areas of corporate management, research, production, development, which is a growing problem in the labour market, because fully automated artificial intelligence systems can replace a significant part of not only low-paid and less qualified jobs (Cu et. al., 2023; World, 2025), but also intellectual human work in important management positions. The diverse possibilities of artificial intelligence embedded in applied software can significantly transform the content and scope of work across various occupations and managerial roles (Amazon, 2024).

In the article, the author deals with current educational problems brought about by technological development and the advent of artificial intelligence and increasing prevalence of remote learning and work, such as: Development of competencies in education; Application of progressive educational methods; Hybrid educational environment; Design and development of digital educational platforms; Creation of didactic educational applications, Instructional Design, etc.

High-level contemporary technologies can effectively support diverse learning formats, such as group, cooperative, and project-based learning, thereby contributing to the development of 4C skills. For effective learning, a dedicated digital platform or framework is necessary that provides a stable foundation for the learning process and supports classes, whether in-person, online, or hybrid. It is important that the platform is available for learning and completing assignments outside of class and provides space for teacher–student and student–student communication.

Such academic-content digital learning platforms can support learning more effectively when UX/UI experts from the market sector are involved in their visual and functional design. The methodology of UX/UI design and research

has been established and has developed into a distinct field; however, it has not yet been integrated into the creation of educational websites (Braun, 2025). From a broader perspective, UX/UI design and research belong to the field of Human–Computer Interaction (HCI), within which user behaviour and usage patterns come into focus. However, cooperation between experts from these two domains in designing a platform could result in more experiential, usable, motivating, and attractive digital learning environments. In this context, Informatics is also an essential area, both because of the technological requirements of hybrid education and the development of the underlying digital framework.
Therefore, when creating Instructional Design suitable for hybrid learning (HxID), experts from the three fields mentioned above need to cooperate to develop effective learning support interfaces (Prantner, 2025).

Keywords: Instructional Design, UX/UI Design, Hybrid educational environment, Progressive educational method.

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HOW HAS AI MADE A TRANSFORMATION IN THE EDUCATION SPHERE?

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Abstract: With the advent of artificial intelligence (AI), the role of a lecturer in tertiary education is transforming. AI resources can serve as potential assistants to lecturers in preparing teaching materials and providing evaluation and feedback to students. Lecturers, in turn, take on one of seven roles (Osadcha et al., 2025) during AI-supported training. Being a reliable information provider while AI serves as a helpful 'assistant' seems the most apparent role in tertiary education. In particular, it applies to teaching Business English at the tertiary level. The use of AI-generated content that is developed by the Pearson Smart Lesson Generator (PSLG) for English lessons (Shumeiko, 2025) allows the lecturer to save time preparing lesson assignments. In this case, the AI resource functions as the lecturer's 'assistant.' At the same time, the lecturer is a reliable provider of information for students in class. The lecturer selects assignments from PSLG content, determines the relevance of AI-generated tasks, and makes adjustments.

Keywords: artificial intelligence, lecturer, tertiary education, training.

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USE OF WEB TECHNOLOGIES IN INFORMATICS EDUCATION

Erik TŰRI, Győző HORVÁTH, HU

Abstract: The rapid spread of the Internet, modern web technologies and digital tools in the recent decades has transformed expectations toward education, influencing the competencies both teachers [1] and students [2] are required to achieve. In many educational contexts, web-based technologies are used primarily as runtime environments: for example, in learning management systems to support teaching or online code execution tools to support programming studies.

This paper reviews these established uses of web technologies in education but argues for a broader pedagogical perspective. The key advantage of the web lies in its universality: applications behave consistently across devices; development can be carried out using free and widely accessible tools. We propose that the web browser itself provides a multimedia-rich and interactive environment that can effectively replace traditional console-based programming tasks or hardware-intensive robotics activities, which may be inaccessible to many schools due to their cost. Web-based programming projects also help boost student motivation and engagement by leveraging multimedia, interactivity and instant feedback that appeal to today's generation of learners [3]. We argue that this approach is feasible because the web as platform readily supports multimedia elements such as embedded bitmap graphics, vector graphics. The creation of such multimedia elements and static websites is already part of the curriculum in Hungary.

Keywords: web technologies, javascript, multimedia, interactivity, browser, informatics education.

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EXPERIENCE-BASED INFORMATICS WITH MICRO:BITS – FROM WANDERING KITS TO HUNGARY'S FIRST NATIONAL MICRO:BIT PROGRAMMING COMPETITION

Andor ABONYI-TÓTH, Bence GAÁL, HU

Abstract: This study presents the more than eight-year development of the national Micro:bit "Wandering Kits" lending program and the pedagogical impacts of Hungary's first Micro:bit Programming Competition. The initiative was grounded in the principles of constructionist and experience-based learning, aiming to provide schools with risk-free access to micro:bit microcontroller devices, thereby supporting teacher-led innovation and informed procurement decisions. Starting from 20 devices, the program expanded through industrial partnerships to several hundred micro:bits, reaching more than 600 schools and approximately 65,000 students by 2025.

Building on this infrastructure, the competition implemented a narrative-driven, project- and problem-based task structure that included both fixed-specification challenges and creative, student-designed problems. The statistical analysis of submitted tasks demonstrates how the dual structure supported differentiated assessment, with the creative tasks activating design, documentation and higher-order problem-solving competences. The implementation relied on a multi-actor collaboration involving university instructors, preservice teachers, mentor teachers from public education and industry partners, who jointly contributed to the organizational, pedagogical and technical aspects of the event.

Findings indicate that the program significantly increased student motivation, creativity and collaboration skills, while strengthening preservice teachers' professional identity and practical pedagogical competences. Together, the Wandering Kits program and the national competition constitute a sustainable, ecosystem-level model that effectively supports the implementation of STEAM-oriented educational innovation in Hungary.

Keywords: micro:bit; constructionism, STEAM education, project-based learning, programming competition, digital pedagogy,student motivation

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METHODS FOR SOLVING TASK TYPES USING SPREADSHEET AND PROGRAMMING

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Abstract: One of the primary goals of the Information Technology (Computer Science) subject is to develop students' problem-solving thinking. Tasks related to data storage and processing constitute a significant and thoroughly covered topic within the subject, and they are often solvable using both spreadsheet software and programming languages. In our previous articles, we highlighted the theoretical possibilities of linking the teaching of spreadsheet and programming. In this publication, we explore the various possible solutions in spreadsheet and in programming for typical data-processing tasks and problems, as well as their conceptual and methodological connections.

Keywords: spreadsheet, programming, problem solving, algorithmic thinking, teaching methods.

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ASSESSMENT OF PUPILS' CREATIVE SKILLS IN TECHNICAL ACTIVITIES: PILOT STUDY

Pavlína ČÁSTKOVÁ, Michal MRÁZEK, CZ

Abstract: Technical education at the primary level represents a key component of the curriculum, supporting the development of manual skills, technical literacy, and creative thinking. These competencies are essential not only for everyday practical functioning but also for pupils' future educational and professional pathways. This study focuses on pupils' perspectives, as their experiences and subjectively perceived conditions for the development of technical skills remain an understudied area that can substantially enrich our understanding of the educational reality. In this context, pupil self-assessment serves as an important indicator revealing how learners evaluate their own abilities and potential in technical skills and technical creativity.

The aim of the article is to present selected findings from a pilot study examining the self-assessment of lower-secondary pupils in the subject *Practical Activities*. The empirical part draws on a questionnaire survey conducted with 78 pupils from grades 6 to 9. A purpose-designed instrument was used to capture pupils' perceptions of technical creativity and the conditions supporting its development. The questionnaire included five-point Likert scales supplemented by several open-ended items and underwent expert content validation by specialists in technology education and educational psychology. The high internal consistency of the instrument (Cronbach's $\alpha \approx 0.91$) confirms its suitability for capturing pupils' perceptions of their technical and creative competencies.

The findings indicate that pupils rate their technical and creative skills as moderately positive, with greater confidence in specific creative activities than in their overall creative self-concept. Gender differences emerged in favour of boys in the domain of tool use and in favour of girls in their creative self-perceptions; however, the structure of relationships among skills was similar for both genders. The analysis also revealed moderately strong associations among different components of technical creativity—particularly between designing and constructing a product—highlighting the complex nature of technical creativity, which integrates cognitive, psychomotor, and imaginative processes.

Keywords: technical education, primary school, self-assessment, technical skills, pupils' creativity, gender differences, Crafts

Funding acknowledgement: Článek vznikl za podpory vědecko-výzkumného grantového projektu GFD_PdF_2024_01 Subjektivní teorie technické tvořivosti učitelů primární školy financovaného Univerzitou Palackého v Olomouci.

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HOW MULTIMEDIA CONTENT SHAPES LEARNING PERFORMANCE IN E-LEARNING: A COMPARISON OF RESULTS BEFORE AND AFTER ITS IMPLEMENTATION

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Abstract: E-learning is becoming an integral and valuable part of the teaching process in contemporary higher education, with its effectiveness determined not only by content but also by form. Research by Dykman and Davis (2008) emphasizes the need for high-quality e-learning courses during the training of future teachers, as a well-designed online course can build bridges between teachers and students and significantly influence the learning process and level of understanding of the subject matter. From the perspective of multimodal learning theory (Turek, 1997 In Töröková & Števčík, 2013), multimedia content processing significantly supports memorization and understanding of information, which is also confirmed by growing empirical evidence in the field of online education. Multimedia is thus a tool that, when used appropriately in teaching, can significantly strengthen student engagement, motivation, and cognitive processes.

The aim of the presented study was to analyze the impact of multimedia content on the performance of university students in the subject Interactive Whiteboard in Education at the Faculty of Education of the University of Presov and, at the same time, to examine the relationships between the evaluation of student outputs and the level of their executive functions measured by selected sub tests of the Slovak adaptation of D-KEFS. The research was conducted over two academic years, with the first group completing the course in its original form without multimedia elements and the second group working with a course supplemented with multimodal content, namely video tutorials on software, interactive presentations, and the Padlet visual collaboration environment. Students were assessed on the basis of the creation of an educational activity using an interactive whiteboard in at least two parts, with the assessment consisting of seven criteria (K1–K7) focused on technical quality, creativity, age appropriateness, work with content, and authorial contribution.

In addition to the point-based assessment, some of the students underwent measurement of executive functions (cognitive flexibility, inhibition, attention) using the Slovak adaptation of the D-KEFS tool, which enabled a correlation

analysis between cognitive prerequisites and the quality of course outputs. The statistical analysis was based on standard significance tests and correlation coefficients to examine the potential monotonic dependence between scores in individual test conditions and the obtained assessment.

The results confirmed that multimedia content had a positive impact on student performance and engagement. The second group achieved higher scores in some criteria, with multimedia materials increasing not only the quality of assignment completion but also course attendance and the level of interaction with educational resources. Correlation analysis revealed the existence of some relationships between D-KEFS scores and assessment criteria, although these did not reach statistical significance. However, more significant links were found between the evaluation criteria themselves—for example, students who showed greater creativity also achieved higher authorial input and more often included motivational elements in their prepared activities.

The discussion points out that multimedia materials can significantly increase the motivational potential of online courses, support more effective information processing, and can also help in the development of higher cognitive processes. In line with the findings of Záhorc, Hašková, and Bílek (2014), multimedia elements also contribute to a change in attitude towards the subject and increase student participation, which was also confirmed in this study. Brutman et al. (2024) found that multimedia resources influence, among other things, the role of students in courses and increase their autonomy and participation in classes, which was confirmed in this research by increased attendance in the course and its individual parts in the selected sample.

The conclusion confirms that multimedia materials are an effective pedagogical tool that can improve the quality of online teaching and learning performance. However, the research has its limitations – the sample is not large enough to represent the entire population. Its results can therefore only be applied specifically to this group. From a methodological point of view, it is also necessary to note the specific context of a single subject and the possible influence of subjectivity in assessment or group testing conditions on the results. Future research should focus on the long-term effects of multimedia, comparing its effectiveness in different disciplines and examining in more detail the interaction between multimodal content and executive functions. A more effectively targeted multimedia environment may contribute to the development of not only cognitive but also metacognitive abilities in students in the future.

Keywords: E-learning, Multimedia, Higher education, Learning outcomes, Future teachers,

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DISRUPTIVE TECHNOLOGIES IN GEOGRAPHY EDUCATION – VIRTUAL REALITY

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Abstract: Geography education, like many other subject areas, needs new, motivating methods for competency-based approaches in primary and secondary schools. Virtual reality (VR) can be a suitable tool for this. It can appear in today's new type of education as a technological tool that offers unprecedented opportunities for immersive, experiential and inquiry-based learning. This study provides an insight into current research on the pedagogical relevance of VR and identifies educational areas where immersive technologies provide a significant motivational base and benefits. VR technology can enable students to virtually explore remote or inaccessible geographical environments, realize classroom visualization of complex geomorphological processes, and support modeling of urban and human geographic systems. In addition, VR-based simulations of natural hazards can promote risk awareness training and decision-making competence. Environmental and climate change-related visualizations can develop ecological understanding. The educational benefits of VR may therefore include increased motivation, improved spatial reasoning, and support for differentiated instruction. However, challenges such as cost and infrastructure remain significant and limit the scope of VR's applicability.

As a first step in our educational development research, VR as an educational material organizing space appeared, in which, taking advantage of the possibilities offered by VR, we grouped the curriculum elements in 3D in a different way than usual, which requires the development of a different ordering principle from the usual, and the navigation can also promote the development of a freer, multi-aspect, new type of approach. For example, we could apply environmental awareness topics, such as the topic related to water.

The next step is to place the geographical curriculum in an appropriate space, which we hope can help not only spatial orientation, but also recall. The implementation of this VR space is in progress.

We hope that VR can be a powerful catalyst for curricular innovation. In our article we outline future developments, positioning immersive technologies as critical elements of the next generation of geography education.

Keywords: virtual reality; geography education; education; teacher training; educational technology; disruptive technology; MaxWhere.

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TASK ANNOTATION FEATURES IN THE PROGCONT SYSTEM

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Abstract: Digital tools are becoming increasingly integrated into teaching and learning. The growing number of students each year and the tools of artificial intelligence present new challenges for educators. At the Faculty of Informatics of the University of Debrecen, we have been using the ProgCont system for the automatic assessment of programming tasks since 2011. Over the years, the system's functionality has steadily expanded, it has become increasingly important for supporting students' independent study. Initially, the system was used to evaluate tasks in programming competitions and later in examinations. During this early phase, feedback was limited to simply accepting or rejecting submitted solutions. A submission is accepted if the program produces the correct output for the given input. Typically, each problem is tested using multiple test cases. To provide more meaningful feedback on rejected submissions, we aim to extend these test cases with annotations that highlight the specific properties of each case. Our intention is to help students identify which subproblems require further improvement when their solutions are only partially correct.

In this presentation, we present the potential of this development. We selected a problem that had received a large number of submissions, created new annotated test cases for it, and re-evaluated all solutions. This allowed us to compare the added value the annotations provide for both students and teachers. The example demonstrates that this development direction is essential for supporting students' self-preparation and for enhancing opportunities for differentiated education.

Keywords: ProgCont system, automatic task evaluation, programming education, annotations

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SPECIFICATION OF EXTREME VALUE TYPE TASKS SPECIFICATION

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Abstract: In introductory programming courses in higher education, the first step in systematic problem solving is the specification of the problem, which is the declarative abstraction of the problem and the basis for designing the solution algorithm. Whether the specification is done in the head, on paper, or their digitized results, it is often incomplete or incorrect. The Specification Editor, developed to check the correctness of the specification, effectively supports the entire process of specification, replacing its writing on paper. With the increasingly widespread use of the Specification Editor, it turned out that the solutions given in theory leave open questions that arise in practice, for which the tool must be prepared. The method, correctness and completeness of specifying tasks related to extreme values also raise questions that need to be answered from several perspectives: as a specialist, as an educator and as a creator of a tool supporting specification creation. In this article, we present alternative options for specifying extreme value type problems, their relationship, and aspects of defining the relation determining the rank.

Keywords: extreme/maximum/minimum value search/filter/select, declarative, specification, cognitive patterns, educational methodology, validation, critical thinking.

SZÉLSŐÉRTÉK TÍPUSFELADATOK SPECIFIKÁCIÓJÁNAK SPECIFIKÁCIÓJA

Absztrakt: A felsőoktatás kezdő programozáskurzusain a módszeres feladatmegoldás első lépése a feladat specifikálása, amely a feladat deklaratív absztrakciója, a megoldó algoritmus tervezésének az alapja. A specifikálást fejben vagy papíron végezve, illetve ezek digitalizált eredménye sokszor hiányos vagy hibás. A specifikáció helyességének ellenőrzésére fejlesztett Specification editor hatékonyan támogatja a specifikálás teljes folyamatát, kiváltja a papírra lejegyzést is. A Specification editor használatának általánossá válása során láthatóvá vált, hogy az elméletben megadott megoldások nyitva hagynak a gyakorlatban felmerülő olyan kérdéseket, amelyekre fel kell készíteni az eszközt. A szélsőértékkel kapcsolatos feladatok specifikálásának módja, helyessége és teljessége is kérdéseket vet fel, melyekre több

szempontból kell válaszolni: szakemberként, oktatóként és specifikációkészítést támogató eszköz készítőjeként. A cikkben bemutatjuk a szélsőérték típusfeladat specifikálásának alternatív lehetőségeit, ezek kapcsolatát, illetve a rangot meghatározó reláció definiálásának szempontjait.

Kulcsszavak: szélsőérték- maximum- minimum-keresés -kigyűjtés - kiválasztás, deklaratív, specifikáció, oktatásmódszertan, validáció, kritikai gondolkodás, reláció, komparátor.

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VIZUALIZÁCIA ALGORITMOV POUŽÍVAJÚCICH ÚDAJOVÚ ŠTRUKTÚRU POLE

Veronika STOFFOVÁ, SK

Abstrakt: Článok podčiarkuje dôležitosť údajových štruktúr v programovom riešení rôznych problémov, reprezentovaných väčším množstvom údajov, ktoré majú byť ľahko dostupné, jednoducho a správne selektovateľné, teda priamo adresovateľné. Preto je dobré, keď sú usporiadané. Najjednoduchšia a najčastejšie používaná údajová štruktúra je pole, ktoré nájdeme ako štandardnú údajovú štruktúru skoro v každom vyššom programovacom jayzku. Práve preto sme vybrali túto údajovú štruktúru ako objekt vizualizácie na vyučovanie a hlbkové učenie sa s porozumením a používaním názorných vizualizovaných simulačných modelov riešenia úlohy.

Kľúčové slová: údajové štruktúry, pole ako údajová štruktúra, implementácia údajovej štruktúry, adresovanie elementu údajovej štruktúry.

VISUALIZATION OF ALGORITHMS USING THE ARRAY DATA STRUCTURE

Abstract: The article underlines the importance of data structures and the method of their internal implementation in the programmingsolution of various problems, represented by a larger amount of data, which should be easily accessible, simply and correctly selectable, i.e. directly addressable. Therefore, it is good when they are organized. The simplest and most frequently used data structure is an array, which we find as a standard data structure in almost every higher programming language. That is why we have chosen this data structure as an object of visualization for teaching and learning with understanding and using illustrative visualized simulation models of solving a task.

Keywords: data structures, array as a data structure, implementation of a data structure, addressing of a data structure element.

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AUTOMATIC FEEDBACK IN PROGRAMMING EDUCATION : A COMPREHENSIVE REVIEW

Dávid DEMETER, Ladislav VÉGH, SK

Abstract: The growing availability of generative large language models (LLMs) has introduced new opportunities for enhancing programming education, particularly through automated feedback systems. Such systems can support learners by providing timely, scalable, and context-aware explanations; however, they also raise challenges related to data privacy, overreliance, and alignment with course content. Locally deployable LLMs, including models such as DeepSeek Coder and WizardCoder, offer a promising alternative to cloud-based solutions, enabling fine-tuning, domain adaptation, and privacy-preserving operation. This paper presents a comprehensive overview of automatic feedback approaches in programming education, with a focused comparative analysis of selected locally deployable generative models. We examine the pedagogical background of effective feedback and analyze the capabilities of two state-of-the-art code-oriented models. Our analysis highlights key pedagogical differences between the two models.

Keywords: automatic feedback, programming education, computer-assisted learning, intelligent tutoring systems, code analysis.

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GAME DEVELOPMENT-BASED LEARNING IN AN INTRODUCTORY PROGRAMMING COURSE

Noémi Bernadett AGÓCS, HU

Abstract: This study presents an example from an introductory programming course that implements game development-based learning (GDBL), an approach in which students learn by designing, creating, or modifying games. The aim of using this approach was to strengthen students' understanding of core programming concepts, such as loops or variables, to help them acquire algorithmic thinking and problem-solving skills, and to provide a motivating learning environment that can help encourage deeper engagement and interest in informatics.

The paper introduces a complex project that follows the software development life cycle (SDLC), guiding students through the creation of a simplified PAC-MAN-inspired maze game in Scratch. Throughout the project, planning, design, animation, and game programming tasks are performed. Working collaboratively, students first analyse user needs, determine core mechanics, narrative elements, and rules, then design the characters and layout of levels for the game. An intermediate implementation-preparation phase introduces learners to 3D modeling and animation before transitioning to the final programming phase, during which students implement movement, collision detection, feedback systems, enemy behaviour, level transitions, and win/lose conditions.

The game development process described in the article was designed not only to reinforce fundamental programming knowledge, but also to broaden students' digital competencies and understanding of design principles. Although the sample size is not yet sufficient for broader generalizations, initial experiments in university preparatory courses and secondary school extracurricular clubs suggest that this method could be effective for teaching beginner programmers. Despite its potential, GDBL remains underexplored in teaching, highlighting the need for structured materials and practical examples.

Keywords: game development-based learning, teaching, programming, project work, Scratch, 3D modelling, animation, introductory course

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DIDACTIC ADVANTAGES OF TURTLE GRAPHICS IN SCRATCH – ANALYSIS AND CASE STUDY

Péter BERNÁT, HU

Abstract: Turtle graphics has been an important part of teaching basic programming for many years, especially for developing algorithmic thinking. However, with the spread of newer teaching methods (such as robotics and game programming), its role seems to be decreasing, and sometimes it is pushed into the background. Traditional turtle-graphics environments have also become outdated. In this article, I first explain the educational advantages of turtle graphics. Then I describe why I think Scratch is a good choice among modern, free programming environments used in education. After that, I give a guide on how turtle graphics can be done in Scratch, what kinds of pedagogical benefits it can have, and what difficulties (caused by the features of the environment) teachers should expect. Finally, within the framework of a brief case study, I present a turtle-graphics assignment given to computer science teacher trainees, which I specifically adapted to the capabilities of Scratch.

Keywords: algorithmic thinking, turtle graphics, block-based programming, Scratch, teaching programming

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TROZVOJ POČÍTAČOVEJ GRAMOTNOSTI ŽIAKOV ZÁKLADNÝCH ŠKÔL

Jana FIALOVÁ, Roman HORVÁTH, SK

Abstrakt: Príspevok sa zaoberá rozvojom počítačovej gramotnosti žiakov základných škôl. Autori charakterizujú aktivity, ktoré boli realizované v prvom roku riešenia projektu KEGA 010TTU-4/2025 s názvom Rozvoj informatického a algoritmického myslenia žiakov prostredníctvom efektívneho začlenenia moderných technológií do vyučovania informatiky a matematiky, najmä realizáciu krúžku programovania pre žiakov základných škôl a interaktívne aplikácie na podporu vyučovania matematiky na prvom stupni základných škôl.

Kľúčové slová: rozvoj počítačovej gramotnosti, krúžok programovania, interaktívne aplikácie, IKT vo vzdelávaní.

DEVELOPING COMPUTER LITERACY AMONG PRIMARY SCHOOL PUPILS

Abstract: The contribution deals with the development of computer literacy among primary school pupils. The authors describe the activities that were carried out in the first year of the KEGA 010TTU-4/2025 project entitled Development of pupils' computational and algorithmic thinking through the effective integration of modern technologies into the teaching of computer science and mathematics, in particular the implementation of a coding club for primary school pupils and interactive applications to support mathematics teaching at primary schools.

Keywords: development of computer literacy, programming club, interactive applications, ICT in education.

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POČÍTAČOVÁ GRAFIKA A JEJ VÝUČBA: PRAKTICKÁ UČEBNICA, CVIČEBNÝ ZOŠIT A VIDEONÁVODY

Simona KUMPANOVÁ, Milan ŠTRBO, SK

Abstrakt: Cieľom tohto článku je predstavenie komplexného elektronického vzdelávacieho materiálu pre výučbu predmetu Počítačová grafika na základných, stredných a vysokých školách. Ale vďaka svojmu jednoduchému systému je vhodný na širšie využitie. Môže slúžiť ako pomôcka pre všeobecnú Informatiku, pre grafické a technické odbory alebo dokonca ako rýchly tréningový kurz pre firmy, ktoré používajú bezplatné grafické nástroje.
Výsledkom práce je didaktický balík pozostávajúci z elektronickej praktickej učebnice, cvičebnice a série videonávodov, ktoré slúžia na podporu moderného a efektívneho vzdelávania. Materiály sú navrhnuté s cieľom rozvíjať praktické zručnosti študentov prostredníctvom bezplatného softvéru Inkscape.

Kľúčové slová: počítačová grafika, Inkscape, vzdelávací material, praktická učebnica, cvičebnica, videonávody.

COMPUTER GRAPHICS AND ITS TEACHING: PRACTICAL TEXTBOOK, EXERCISE BOOK AND VIDEO TUTORIALS

Abstract: The aim of this article is to present comprehensive electronic teaching materials for teaching computer graphics at primary, secondary, and higher education institutions. However, thanks to its simple system, it is suitable for wider use. It can serve as an aid for general computer science, for graphic and technical fields, or even as a quick training course for companies that use free graphic tools.
The result of the work is a didactic package consisting of an electronic practical textbook, a workbook, and a series of video tutorials that serve to support modern and effective education. The materials are designed to develop students' practical skills using the free Inkscape software.

Keywords: computer graphics, Inkscape, educational material, practical textbook, exercise book, video tutorials.

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BLENDED LEARNING VO VYUČOVANÍ MATEMATICKÝCH PREDMETOV

Jana FIALOVÁ, SK

Abstrakt: Príspevok sa zaoberá využitím blended learningu vo vyučovaní matematických predmetov pre študentov predškolskej a elementárnej pedagogiky a učiteľstva pre primárne vzdelávanie. Autorka charakterizuje najdôležitejšie dosiahnuté výsledky počas troch rokov riešenia projektu KEGA 001UMB-4/2023 s názvom Implementácia blended learningu do prípravy profesijného bakalára z informatiky a budúcich učiteľov matematiky a informatiky.

Kľúčové slová: blended learning, online learning, flipped classroom, IKT vo vzdelávaní.

BLENDED LEARNING IN TEACHING MATHEMATICS

Abstract: The article deals with the use of blended learning in teaching mathematics subjects to students of Pre-school Elementary Pedagogy and Primary Education Teaching. The author characterizes the most important results achieved during the three years of the KEGA 001UMB-4/2023 project entitled Implementation of blended learning in the training of professional bachelors and teachers of mathematics and computer science.

Keywords: blended learning, online learning, flipped classroom, ICT in education.

Acknowledgement: The contribution was supported by the KEGA 001UMB-4/2023 project.

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THE EFFECTIVENESS OF THE FLIPPED CLASSROOM MODEL IN EDUCATION

Ildikó PŠENÁKOVÁ, SK

Abstract: The *Flipped Classroom* model is one of the most innovative and rapidly developing approaches in contemporary education, fundamentally reversing the traditional structure of the teaching–learning process. In classical instruction, the teacher presents new material during the lesson and students practice at home, while in the flipped model this sequence is reversed: learners engage with new content before class, using digital resources such as instructional videos, interactive presentations, online courses, or e-learning platforms. Class time is thus devoted to discussion, problem solving, collaboration, and practical application, leading to more active and engaging learning experiences.

Implementing the model requires a new pedagogical mindset, as the teacher's role also transforms—from a knowledge transmitter to a facilitator and mentor who supports students in applying knowledge in practice and developing critical and self-reflective thinking. The method also allows for differentiated instruction, since learners can progress at their own pace while receiving individualized feedback.

During the implementation of the model, students received digital learning materials in advance, and the lessons were conducted either online (via MS Teams) or in a face-to-face setting. The study was carried out at the Faculty of Education, Trnava University, within two courses at the Department of Mathematics and Informatics during the 2024/2025 academic year.

The aim of the research was to examine to what extent the Flipped Classroom model contributes to the improvement of students' learning outcomes, motivation, and autonomy in higher education. A total of 48 students participated in the experiment, divided into two groups over the course of one semester: one group followed traditional instruction, while the other applied the Flipped Classroom method.

Digital materials were distributed four to five days prior to each class. During the interactive sessions, students shared their screens, solved problems collaboratively or under the teacher's guidance, and actively reflected on one another's work. Learning outcomes were analysed using the Wilcoxon signed-rank test, based on performance measured at the beginning and end of the semester. The results remained below the 0.05 significance level ($p < 0.05$),

indicating a significant improvement in students' academic performance and confirming that flipped learning effectively develops autonomy, responsibility, and deeper understanding.

Student feedback also highlighted the positive impact of the method on motivation, independence, learning engagement, and collaboration, as well as on the experiential nature of learning. Although the implementation of the model requires greater teacher preparation and time investment, the findings show that these efforts pay off in the long term.

Overall, the Flipped Classroom represents not merely a technological innovation, but a pedagogical paradigm shift that combines the advantages of digital innovation and active learning. The method contributes to the renewal of education by fostering learners' autonomy, collaboration, and sense of responsibility, thus representing one of the most promising directions in 21st-century education.

Keywords: Flipped Classroom, Active Learning, Digital Pedagogy, Educational Effectiveness

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STUDENTS CHEATING DURING ONLINE TESTING

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Abstract: Internet learning together with distance learning make up an online education, therefore this paper provide short introduction to online education, shows advantages and disadvantages. This study examines the impact on academics such as primary schools and universities, and shows effects towards online education. The research about whether students cheat more during online classes or live classes was conducted and data was analysed. In this work the questionnaire method was used. The studies found that students rather cheat during live classes in comparison to the online, distant classes.
Keywords: distance learning, cheating, online education,

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MOŽNOSTI VYUŽITIA UMELEJ INTELIGENCIE VO VZDELÁVANÍ: INOVATÍVNE PRÍSTUPY SO ZAMERANÍM NA DIGIEDUHACK BRATISLAVA

József UDVAROS, Veronika GABAĽOVÁ, Jarmila PELDOVÁ, Mária FÁBEROVÁ, SK

Abstract: Digitálna transformácia vzdelávania je aktuálne výrazne ovplyvňovaná umelou inteligenciou (AI), ktorá prináša nové možnosti personalizovaného učenia, tvorby interaktívneho obsahu alebo aj podpory inkluzívnych prístupov. Moderné systémy založené na AI dokážu reagovať na potreby jednotlivých žiakov, ponúkať im individuálne prispôsobené učenie, spätnú väzbu a vhodné materiály podľa ich schopností a preferencií. Príspevok vychádza aj z poznatkov získaných na podujatí DigiEduHack, ktoré sa konalo v dňoch 14 a 15.11. 2025 v Bratislave. Toto podujatie podporuje vznik inovatívnych vzdelávacích riešení a prepája študentov, pedagógov a odborníkov z oblasti digitálnych technológií. Príspevok poukazuje taktiež na využitie rôznych platforiem AI, vďaka ktorým je možné vytvárať moderné, interaktívne a umelou inteligenciou obohatené vzdelávacie materiály. Tieto zvyšujú motiváciu žiakov, podporujú ich kreativitu a robia vyučovanie atraktívnejším.

Príspevok sa taktiež venuje širším trendom zavádzania AI do škôl a rozoberá jej pedagogické prínosy, ale aj riziká a výzvy spojené s jej používaním. Taktiež poukazuje na spôsoby ako môže AI zlepšiť aktivitu žiakov, posilniť kritické myslenie a prispieť k lepším vzdelávacím výsledkom. Nesmieme však opomenúť, že jej implementácia si vyžaduje riešenie etických a právnych otázok, ochranu osobných údajov, prekonávanie technologických obmedzení a dôkladnú prípravu učiteľov. V závere príspevok prináša odporúčania pre pedagógov a školy a tiež zdôrazňuje potrebu zodpovednej a premyslenej integrácie AI do vyučovania. Iba prepojením technologických inovácií s kvalitnými pedagogickými prístupmi môže AI reálne podporiť inkluzívne, tvorivé a efektívne vzdelávanie pre všetkých.

Keywords: Umelá inteligencia, Vzdelávanie, DigiEduHuck, Technologické inovácie

POSSIBILITIES OF USING ARTIFICIAL INTELLIGENCE IN EDUCATION: INNOVATIVE APPROACHES WITH A FOCUS ON DIGIEDUHACK BRATISLAVA

Abstract: The digital transformation of education is currently strongly influenced by artificial intelligence (AI), which brings new possibilities for personalized learning, the creation of interactive content, and the support of inclusive approaches. Modern AI-based systems can respond to the needs of individual students by offering personalized learning, tailored feedback, and suitable materials according to their abilities and preferences. This paper also draws on insights gained at the DigiEduHack event, which took place on 14–15 November 2025 in Bratislava. The event supports the development of innovative educational solutions and connects students, teachers, and experts in digital technologies. The paper also highlights the use any kinds of AI platforms, which enables the creation of modern, interactive, and AI-enhanced learning materials. These materials increase student motivation, support their creativity, and make the learning process more engaging.

The paper also addresses broader trends in the integration of AI into schools and examines its pedagogical benefits as well as the risks and challenges associated with its use. It points to the ways in which AI can enhance student engagement, strengthen critical thinking, and contribute to improved learning outcomes. However, it should not be overlooked that implementing AI requires addressing ethical and legal issues, ensuring data protection, overcoming technological limitations, and providing thorough teacher training. In conclusion, the paper offers recommendations for educators and schools and emphasizes the need for responsible and well-planned integration of AI into teaching. Only by combining technological innovation with high-quality pedagogical approaches can artificial intelligence genuinely support inclusive, creative, and effective education for all.

Keywords: Artificial Intelligence, Education, DigiEduHuck, Technological Inovation

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FUTURE TEACHERS AND THEIR USE OF ONLINE TECHNOLOGIES

Miroslav CHRÁSKA, CZ

Abstract: The paper describes selected results of a research that investigated the possibilities of online technologies in the field of informal learning and formal education for student-future teachers using a mixed research design. We primarily focus on the results obtained in the fourth stage of this research, which was quantitative in nature and aimed to verify whether future teachers, according to the way they use online technologies, are divided into two typical groups.

A self-constructed questionnaire was compiled as a research method and generalized cluster analysis was used to process the research results to verify the assumed types of typical users of online technologies among student-future teachers.

The research sample (baseline) consisted of all first-year students of bachelor's degree programs, students of the first and second years of follow-up master's degree programs and fourth and fifth years of long master's degree programs at the Faculty of Education of Palacký University in Olomouc (n=1212). These were students at the beginning of their university studies (B.Sc. students) and at the end of their university studies (NMgr. students and students in higher years of Mgr. studies). Unfortunately, the research sample ultimately consisted of "only" 334 students, of which 144 were bachelor students and 190 were master and follow-up master study programs, who answered all questions in the questionnaire.

Using generalized K-Means cluster analysis, the division of students – future teachers into two significantly different clusters according to their way of working with online technologies was clearly confirmed.

The analyzed data shows that future teachers in group 1 (cluster 1, year of birth 1999 predominates) tend to use online technologies for formal education – in this area, they mention mainly educational applications (such as Duolingo), tutorials (e.g. YouTube), but also video content (e.g. on YouTube and Netflix).

Future teachers in group 2 (cluster 2, year of birth 2000 predominates) tend not to use online technologies, games, simulations (e.g. Minecraft or League of Legends) for formal education, but they do not use them for informal learning either.

Both groups of students agree that they use online technologies to support informal learning, not for formal education.

Keywords: future teachers, online technologies, cluster analysis, informal learning, formal education.

BUDOUCÍ UČITELÉ A JEJICH ZPŮSOB VYUŽITÍ ON-LINE TECHNOLOGIÍ

Abstrakt: Příspěvek popisuje vybrané výsledky výzkumu, který zkoumal možnosti online technologií v oblasti informálního učení a formálního vzdělávání u studentů – budoucích učitelů pomocí smíšeného výzkumného designu. Primárně se zaměřujeme na výsledky, které byly získány ve čtvrté etapě tohoto výzkumu, která měla kvantitativní charakter a jejímž cílem bylo ověřit, zda se budoucí učitelé, podle způsobu využití on-line technologií, dělí do dvou typických skupin.

Jako výzkumná metoda byl sestaven dotazník vlastní konstrukce a pro zpracování výsledků výzkumu byla použita zobecněná shluková analýza pro ověření přepokládaných typů typických uživatelů on-line technologií u studentů – budoucích učitelů.

Výzkumný vzorek (základní soubor) tvořili všichni studenti prvních ročníků bakalářských studijních programů, studenti prvních a druhých ročníků navazujících magisterských studijních programů a čtvrtých a pátých ročníků dlouhých magisterských studijních programů na Pedagogické fakultě Univerzity Palackého v Olomouci (n=1212). Jednalo se tedy o studenty na začátku jejich VŠ studia (Bc. studenti) a ke konci VŠ studia (NMgr. studenti a studenti ve vyšších ročnících Mgr. studia). Bohužel výzkumný vzorek nakonec tvořilo "jen" 334 studentů, z toho 144 studentů bakalářských a 190 studentů magisterských a navazujících magisterských studijních programů, kteří odpověděli na všechny otázky v dotazníku.

Pomocí zobecněné K-Means shlukové analýzy bylo jednoznačně potvrzeno rozdělení studentů – budoucích učitelů na dva významně odlišné shluky podle jejich způsobu práce s on-line technologiemi.

Z analyzovaných dat vyplývá, že budoucí učitelé ve skupině 1 (shluk 1, převládá rok nar. 1999) mají tendenci využívat on-line technologie k formálnímu vzdělávání – v této oblasti uvádí především vzdělávací aplikace (jako např. Duolingo), tutoriály (např. YouTube), ale také videoobsah (např. na YouTube a Netflix).

Budoucí učitelé ve skupině 2 (shluk 2, převládá rok nar. 2000) spíše nevyužívají on-line technologie, hry, simulace (např. Minecraft nebo League of Legends) pro formální vzdělávání, ale nevyužívají je ani pro informální učení.

Obě skupiny studentů přitom souhlasí s tím, že on-line technologie používají spíše k podpoře informálního učení, nikoliv k formálnímu vzdělávání.

Klíčová slova: budoucí učitelé, on-line technologie, shluková analýza, informální učení, formální vzdělávání.

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INOVÁCIE VO VZDELÁVANÍ: IMPLEMENTÁCIA NOVÝCH TRENDOV Z POHĽADU MLADEJ GENERÁCIE

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Abstrakt: Význam vzdelania a kvalifikačný potenciál národa priamo závisia od adaptability školského systému na potreby intelektuálnej a materiálnej sféry. Súčasná transformácia vzťahu medzi vzdelávaním a praxou kladie vysoké nároky na osobnosť učiteľa, ktorý musí byť schopný inovovať obsah aj metódy výučby. Predložený príspevok vychádza zo zásady, že univerzitná príprava musí pedagógov formovať tak, aby dokázali reflektovať individuálne schopnosti študentov a rozvíjať ich potenciál. V kontexte týchto inovácií práca prezentuje implementáciu praktických vedeckých aktivít do edukačného procesu. Cieľom je poukázať na to, ako praktická výskumná činnosť budúcich učiteľov prispieva k zmene ich prístupu k výučbe a k efektívnemu prepojeniu teórie s požiadavkami modernej vedeckej praxe.

V príspevku prezentujeme, aké je dôležité zvýšiť záujem mladých ľudí o oblasť chemických analýz, s čím súvisí aj ich vedomostný rast. Najdôležitejšou fázou je práve motivačná fáza vzbudenia záujmu, túžby a chuti niečo dosiahnuť, dokázať a niečo nové vytvoriť. K plnej sebarealizácii človek potrebuje disponovať takými základnými poznatkami, zručnosťami a návykmi, ktoré sa dajú uplatniť v každodennom živote. Účasť na vedeckých konferenciách je jednou z príležitostí, ktoré umožňujú mladým ľuďom prepojiť vedecké myslenie a prezentáciu svojich osobitných názorov prostredníctvom vedeckých prác.

Predložený príspevok reflektuje inovatívne prístupy vo vzdelávaní mladých vedcov prostredníctvom praktickej vedeckovýskumnej činnosti študentov / doktorandov. Práce študentov prezentované na vedeckej konferencii sa zameriavajú na aktuálne témy z oblasti aplikovanej chémie a environmentálnych vied. Konkrétne ide o analýzu antioxidačných vlastností čajových extraktov a stanovenie obsahu vitamínu C, ako aj o hodnotenie fyzikálno-chemických parametrov rôznych typov vôd. Veľa práce súvisiacej s chémiou si vyžaduje laboratórny výskum, a preto je veľmi dôležité zvýšiť záujem mladšej generácie o možnosti laboratórneho výskumu a jeho praktické aplikácie.

Kľúčové slová: vzdelávanie, motivácia, chémia, študent, pedagóg, vedecko-výskumná činnosť.

INNOVATIONS IN EDUCATION: IMPLEMENTATION OF NEW TRENDS FROM THE PERSPECTIVE OF THE YOUNG GENERATION

Abstract: The importance of education and the qualification potential of a nation directly depend on the adaptability of the school system to the needs of the intellectual and material spheres. The current transformation of the relationship between education and practice places high demands on a teacher's personality, requiring them to innovate in both the content and methods of teaching. The presented work is based on the thesis that university training must prepare teachers to reflect on students' individual abilities and develop their potential. In the context of these innovations, the work presents the implementation of practical scientific activities into the educational process. The aim is to point out how the practical research activity of pre-service teachers contributes to changing their approach to teaching and to effectively connecting theory with the requirements of modern scientific practice.

In the paper, we present the importance of increasing young people's interest in the field of chemical analysis, which is also related to their knowledge growth. The most important phase is the motivational phase, which arouses interest, desire, and appetite to achieve, prove, or create something new. For full self-realisation, a person needs basic knowledge, skills, and habits that can be applied in everyday life. Participation in scientific conferences is one of the opportunities that allow young people to connect scientific thinking with the presentation of their unique opinions through scientific papers. The paper presents innovative approaches to educating young scientists through students'/doctoral candidates' practical scientific research activities. The students' works presented at the scientific conference focus on current topics in applied chemistry and environmental sciences. Specifically, it concerns the analysis of the antioxidant properties of tea extracts, the determination of vitamin C content, and the evaluation of the physicochemical parameters of various types of water. Much chemistry-related work requires laboratory research, which is why it is very important to increase the younger generation's interest in the possibilities of laboratory research and its practical applications.

Keywords: education, motivation, chemistry, student, teacher, scientific research activity.

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DOŠKOLOVACÍ KURZY NA ZVÝŠENÍ KOMPETENCÍ UČITELŮ V OBLASTI EDUKAČNÍ ROBOTIKY

Hana HYKSOVÁ, CZ

Abstrakt: Digitální technologie přinášejí do vzdělávání řadu nových příležitostí. Schopnost jednotlivce využívat digitální technologie k učení, vzdělávání a zdokonalování svých dovedností je jednou z důležitých složek digitální gramotnosti a je nezbytná pro schopnost celoživotního učení jedince. Integrace digitálních technologií do výukových aktivit a školního života a propojení formální výuky s neformálními vzdělávacími aktivitami žáků je proto další nezbytnou součástí rozvoje digitální gramotnosti žáků.
Úkolem učitelů není jen vzdělávání a odborná příprava, ale také příprava žáků na budoucí povolání. Právě do přípravy na budoucí povolání patří i robotika. Robotika je obor, který zahrnuje řadu očekávaných výstupů Rámcového vzdělávacího programu, z něhož se formují školní vzdělávací programy platné pro základní i střední školy. Nejdůležitějšími pojmy ve vzdělávání jsou: počítačové myšlení, digitální gramotnost, algoritmizace, robotika, programování. Všechny tyto dovednosti jsou potřebné nejen v informatice, ale i v dalších oborech a předmětech. Ke zvýšení kompetencí učitelů v oblasti edukační robotiky jsou doškolovací kurzy, semináře či webináře nezbytné.

Klíčová slova: vzdělávací technologie, vzdělávání učitelů, celoživotní vzdělávání, kvalita vzdělávání, digitální technologie.

CONTINUING TRAINING COURSES TO INCREASE TEACHERS' COMPETENCES IN THE FIELD OF EDUCATIONAL ROBOTICS

Abstract: Digital technologies bring a number of new opportunities to education. An individual's ability to use digital technologies to learn, education and improvement their skills is one of the important components of digital literacy and is essential for an individual's lifelong learning ability. The integration of digital technologies into teaching activities and school life and the connection of formal teaching to non-formal educational activities of pupils is therefore another necessary part of the development of pupils' digital literacy.

The task of teachers is not only education and training, but also the preparation of students for future occupations. It is the preparation for the future profession that includes robotics. Robotics is a field that includes a number of expected outputs of the Framework Educational Program, from which School

Educational Programs valid for primary schools as well as secondary schools are formed. The most important concepts in education are: computer thinking, digital literacy, algorithmization, robotics, programming. All these skills are needed not only in computer science, but also in other fields and subjects. To increase teachers' competences in the field of educational robotics, refresher courses, seminars, or webinars are necessary.

Keywords: educational technology, teacher education, lifelong learning, quality of education, digital technologies.

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ANALYTICKÉ METÓDY PRI CHARAKTERIZÁCII POVRCHOVÝCH VÔD VO VZDELÁVANÍ

Michaela ANTALOVÁ, Ján ŠORMAN, SK Agnieszka KANIA, PL

Abstrakt: Štúdia sa zaoberá problematikou implementácie metód analytickej chémie do vyučovacieho procesu so zameraním na hodnotenie kvality povrchových vôd. V kontexte súčasných environmentálnych problémov predstavuje analýza vody ideálnu možnosť pre rozvoj prírodovednej gramotnosti a praktických zručností študentov v rámci univerzitného vzdelávania. Štúdia analyzuje didaktický potenciál vybraných metód pri stanovovaní fyzikálno-chemických parametrov povrchových vzoriek vôd.

Z hľadiska didaktiky chémie zdôrazňujeme prechod od teoretických vedomostí k bádateľsky orientovanému vyučovaniu. Využitie reálnych vzoriek z lokálnych vodných útvarov zvyšuje motiváciu študentov a umožňuje im pochopiť vzťah medzi antropogénnou činnosťou a chemickým zložením hydrosféry. Výsledkom je návrh inovovaných analýz, ktoré zlúčia moderné inštrumentálne spôsoby analýz s klasickými odmernými metódami, čím sa posilní interdisciplinárny charakter výučby a environmentálne povedomie študentov.

Kľúčové slová: analytická chémia, povrchové vody, didaktika chémie, bádateľsky orientované vyučovanie, environmentálne vzdelávanie.

ANALYTICAL METHODS IN SURFACE WATER CHARACTERIZATION IN EDUCATION

Abstract: The study examines the implementation of analytical chemistry methods in the teaching process, with a focus on assessing the quality of surface waters. In the context of current environmental problems, water analysis offers an ideal opportunity for students to develop scientific literacy and practical skills within the framework of university education. The study analyses the didactic potential of selected methods in determining the physicochemical parameters of surface water samples.

From the point of view of chemistry didactics, we emphasise the transition from theoretical knowledge to research-oriented education. Using real samples from local water bodies increases students' motivation and helps them understand the relationship between anthropogenic activity and the chemical composition of the hydrosphere. The result is a proposal for innovative analyses that combine modern instrumental methods with classical volumetric

methods, thereby strengthening the interdisciplinary nature of teaching and students' environmental awareness.

Keywords: analytical chemistry, surface waters, chemistry didactics, inquiry-based science education, environmental education.

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ŠKOLSKÝ DILATOMETER – KALIBRÁCIA

Ján ONDRUŠKA – Igor ŠTUBŇA – Štefan CSÁKI

Resumé: V príspevku je opísaný školský dilatometer pre pevné látky pracujúci na diferenčnom princípe. Je poskladaný z korundových tyčiek, pórovitej izolačnej tehly, dĺžková zmena sa meria výchylkomerom s citlivosťou 0,01 mm. Maximálna pracovná teplota 600 °C dáva možnosť ukázať niektoré premeny vo vhodných vzorkách, napr. v mineráloch, hlinách, dreve. Je ukázaná kalibrácia dilatometra pomocou referenčnej vzorky z konštrukčnej ocele.

Kľúčové slová: teplotná rozťažnosť, školský dilatometer, kalibrácia dilatometra

SCHOOL DILATOMETER – CALIBRATION

Abstract: This study describes a differential dilatometer designed for educational purposes. The apparatus consists of alumina rods, furnace and porous insulating brick; changes in the sample length are recorded by a displacement gauge with a resolution of 0.01 mm. A maximum working temperature 600 °C enables the observation of structural changes in materials such as solid minerals, dry clays, and wood. Furthermore, the calibration procedure using a steel reference sample is described.

Keywords: thermal expansion, school dilatometer, calibration of dilatometer

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Editors: Prof. Ing. Veronika Stoffová, CSc.
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Graphic editors:

Title: **XXXVIIIth DIDMATTECH 2025**

New methods and technologies in education, research and practice

ABSTRACTS

Pages: 82 pages

Preparing to print: Authors of abstracts &
Prof. Ing. Veronika Stoffová, CSc.
PaedDr. Krisztina Czakóová, PhD.
Mgr. Ing. Roman Horváth, PhD.

Print:

First edition

ISBN 978-80-568-0797-2

EAN 9788056807972