



**15th INTERNATIONAL CONFERENCE
OF DOCTORAL STUDIES
IN THE FIELD OF EDUCATION
OF NATURAL SCIENCES**



**November 22-23, 2019
Komárno, Slovak Republic**

ABSTRACT BOOK



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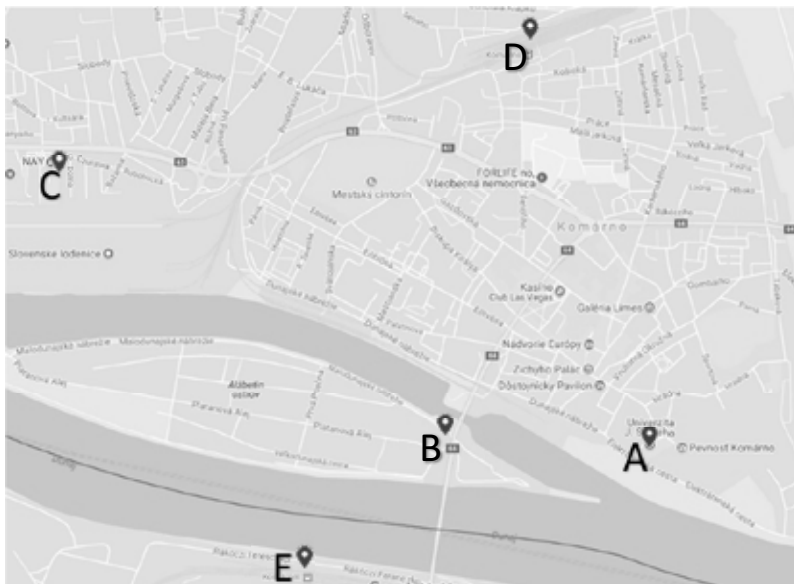


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ABSTRACTS

In the alphabetical order of the first authors

Formative Assessment in Chemistry Education

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The Slovak system of education uses normative forms of assessment, preferring external and summative assessment. The OECD evaluation team has pointed out that regular student testing in Slovakia is not sufficiently formative and there is a strong need to provide students with feedback to help them improve at learning. The OECD suggests for the Slovak system of education to incorporate “formative assessment elements” to capture not only “what” the students are learning and “what results” they achieve, but also “how” they are learning [1].

The aim of the paper is to provide information on the possibilities of implementing a formative assessment in the teaching of chemistry in the 7th grade of elementary school and about the effectiveness of such teaching. First, we created formative evaluation tools for the Mixes theme such as the self-assessment card, Frayer model, prediction card, KWL, exit card. Subsequently teachers (5 teachers) have implemented formative assessment tools into teaching in control and experimental groups. Both groups were taught by the same teachers. At the end of the research the students of both groups were given a cognitive test consisting of 10 tasks focused on 4 levels of Bloom’s revised taxonomy (remembering, understanding, application, analysis). In the next section we will evaluate the results statistically. At the same time, we will follow the opinions and attitudes of pupils to formative evaluation by means of the questionnaire of our own construction.

Keywords: formative assessment classroom techniques, mixtures

Acknowledgements:

This work was created in the framework of the National project “IT Academy – Education for the 21st Century”, which is supported by the European Social Fund and the European Regional Development Fund in the framework of the Operational Programme Human Resources, ITMS code of the project: 312011F057 and by the grant VEGA No. 1/0265/17 “Formative Assessment in the Teaching of Natural Sciences, Mathematics and Informatics”.

References

- [1] Shewbridge, C., van Bruggen, J., Nusche, D., Wright, P., (2014). OECD Reviews of Evaluation and Assessment in Education: Slovak Republic, *OECD Reviews of Evaluation and Assessment in Education*, retrieved from <https://doi.org/10.1787/9789264117044-en>

Research methodology in the doctoral dissertation entitled: Influence of organizational conditions on the effectiveness of teaching chemistry at primary schools

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The research methodology is necessary knowledge in research work, regardless of the topic it concerns. Each field of science has its own developed methodologies. In empirical research, we can distinguish such elements of the research process as: analyzing the literature on the subject, identifying a research gap, creating a research model, formulating research hypotheses, collecting data, conducting proper research, data analysis, research conclusions, accepting or rejecting research hypotheses [1].

The article contains a fragment of promotion work, the aim of which is to analyze the effectiveness of the current use of the method of work organization optimization (teaching, and especially learning) in teaching chemistry and the general educational subject. It will be the analysis of processes such as: planning and time management, optimization of the use of methodological materials, managerial applications teaching methods of chemistry, etc. The article presents a fragment of thesis on research methodology, in particular:

1. Formulating the research problem and determining its type (descriptive, relational, causal).
2. Definition of research goals.
3. Formulating research hypotheses.
4. Description of the selection of the research sample and determination of its type.
5. Characteristics of the research instrument used and level specification measurement (nominal, ordinal, interval, ratio) of his position.
6. Specification of the statistical data analysis procedure and methods used statistical data analysis.

The article is an attempt to look at the implementation of the research project from the perspective of the researcher, the procedure for the preparation and execution of the dissertation is to be the result of justified and reasonable and well-organized research.

Keywords: methodology of pedagogical research, time management, teaching chemistry

References

- [1] Pilch T., Bauman T.: Zasady badań pedagogicznych: strategie ilościowe i jakościowe. "Żak", Warszawa 2010

Naive axioms of high school students

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By phenomenological primitives we mean axioms based on experience whose truth is accepted without giving it a second thought [1]. Contrary to misconceptions, p-primes are not formed during studies but through a process in which conclusions – often incorrect ones – are drawn from everyday experiences. These conclusions often prove to be useful even in solving certain scientific problems.

The aim of our country-wide survey, including more than 3,500 people and conducted since 2017, has been to explore high school students' existing p-primes related to Chemistry.

A survey of this scale has not been carried out with p-primes in Chemistry in Hungary. Based on the experiences coming from a previously conducted study on a smaller scale, we included participants from grammar, vocational high and vocational schools. Students of the ninth and tenth form had to solve 12 open-ended questions. Among these questions there were issues that were definitely discussed in class (e.g. questions related to the size of atoms), but there were others as well, the solution of which most probably everyday experiences helped the most (e.g. the flammability of gas cans).

Keywords: phenomenological primitives

References

[1] diSessa, A. A. (1993). Toward an Epistemology of Physics. *Cognition and Instruction*, 10(2&3), 105-225.

Chemistry and integrated teaching of natural sciences in secondary schools

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The presentation will be focused on content and procedure of dissertation work. Theoretical part will contain information about history and present situation of integrated teaching in the Czech Republic, eventually in the world. Present situation of integrated teaching in the Czech Republic will be ascertained by questionnaire and half structured interviews. The analysis of materials for integrated teaching in the Czech Republic and in the world will be included. Practical part will contain a file of worksheets, which will be processed in an integrated way. Worksheets will include a part of educational content of inorganic chemistry in grammar school with possible overlap into general chemistry, organic chemistry and biochemistry. Each worksheet will be supplemented with methodical sheet for teachers. Filled worksheets and self-evaluation questionnaires will be statistically processed and evaluated.

Keywords: integrated teaching, worksheets for integrated teaching, teachers opinion, self-evaluation questionnaire

The Teacher's Creative Digital Literacy (*plenary lecture*)

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Digital literacy of teachers has advanced with the development of digital technologies and their application at schools. At the turn of the 21st century, teachers learned how to handle a personal computer, install software, use the Windows operating system, and the Microsoft Office suite. Later, teachers began to use multimedia and web sites from the Internet as a suitable source of information in the educational process.

Everyday usage of mobile devices, laptops, tablets, mobiles has contributed to the incidence of new educational phenomena, such as social networking, cloud applications, learning and virtual environments, artificial intelligence. These are the current challenges for in-service teachers and pre-service teachers studying at universities. Digital technologies are fast-growing tools whose creative and innovative options can be used effectively by teachers if their creative digital literacy is well developed.

Office 365 provides a comprehensive environment for teachers and students for cognitive and learning processes, as well as for communication, cooperation and formative evaluation.

The OneDrive, ClassNote, and Teams apps are the new Office 365 tools that give the conditions for the creation and use of the student's e-portfolio, e-portfolio of the subject (Szarka, 2018), and for pedagogical and research collaboration. In our project "Education for the information society" we want to develop creative digital competences for pedagogical and research work of students and doctoral students in the cloud Office 365.

Keywords: creative digital literacy, Office 365, TEAMS, ClassNote, e-Portfolio

Acknowledgements:

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References

- [1] Szarka, K. a kol. 2018. *Inovácie v pregraduálnej príprave učiteľov s využitím webových aplikácií*. Komárom : Kompress NyomdaipariKft., 2018. ISBN 978-615-00-2597-1.

Application of the Mathematical Skills in chemistry tasks

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The concept of Mathematical Skills refers to an ability when the mathematical knowledge is effectively and efficiently used to solve real problems. [1] This ability is important for students of chemistry not only in chapters of chemical calculations. It is used also in topics, such as molecular shapes, interpretation of statistical data, describing the properties of functions, etc. Development of Mathematical Skills is important for understanding chemistry problems. [2] The radiocarbon dating in archeology is often easily understood by students, but the calculation of age of objects is more difficult for them for it requires the ability of solving the exponential equation. Similarly, students often learn the sizes of bonding angles in molecules as simple facts with no attempts to deduce it. There was created a concept of a didactic test to verify the level of mathematical skills of students of the 4th grade of grammar schools and a pilot testing was realized.

Keywords: mathematical skills – chemistry education – didactic test

References

- [1] Palečková J., Tomášek V., Basl J., Blažek R. & Boudová S. *Hlavní zjištění PISA 2012 Matematická gramotnost patnáctiletých žáků*. Praha: Česká školní inspekce, 2013.
- [2] Hoban R. A., Finlayson O. E. & Nolan B. C. (2013). Transfer in chemistry: a study of students' abilities in transferring mathematical knowledge to chemistry. *International Journal of Mathematical Education in Science and Technology*. 44 (1), pp. 14-35

Activities with mobile technologies in teaching of physics

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Teaching is a complex process that reflects changes in society and modifies its character. Compared to the past, teaching does not focus on the transfer of information from teacher to pupil but furthers the development of pupils' competences and skills for working with information. The competences and skills that pupils should develop during their lessons are formulated in the concept of skills for the 21st century. [1] These competences and skills are based on a change in the availability of information. Digital technologies have changed the world and make a lot of information available.

The latest digital technologies include mobile technologies, smartphones and tablets. These technologies have taken a prominent place in society. They are used by different age groups of people daily in different situations. Mobile technologies are also implemented in the educational process in Slovakia. Learning using mobile technologies is described by the theory of mobile learning.

In dissertation thesis we deal with the implementation of mobile technologies in teaching of physics. In the paper we characterize the theory of mobile learning, we present activities for teaching using mobile technologies, the way of their implementation and the proposal of the research connected with the dissertation.

Keywords: mobile learning, mobile technologies, activities for teaching, implementation

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References

- [1] Pacific Policy Research Center, 2010. 21st Century Skills for Students and Teachers. [online]. Honolulu: Kamehameha Schools Research and Evaluation. 2010. s. 25. Available online: http://www.ksbe.edu/_assets/spi/pdfs/21_century_skills_full.pdf

Relationship Among Active Learning of Students, Their Attitude to Chemistry and Performance Motivation

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The aim of this research was to find out how beginning students will perceive teaching methods based on their active work. The research sample included two classes after their first year of chemistry at an eight-year grammar school (year 8) and one class after 5 years of chemistry at the same school (year 11). Students completed a questionnaire on attitudes to subjects with seven statements, a performance motivation questionnaire on attitudes to subjects with fourteen statements, and four open questions on chemistry teaching in the current year. Five laboratory works were introduced in the school during one year. Other tasks were implemented in regular lessons, forcing students to participate actively in chemistry lessons: games, student presentations, group work, active home preparation of simple experiments or chemical diary, repetition using worksheets, writing excursion reports and laboratory protocols. The need for this active learning of students emerged from previous research at this school. The students perceived this style of teaching positively, but it was necessary to verify whether this would be reflected in their attitude to the subject of chemistry. It was also necessary to compare the feedback of students with their performance motivation. In the following years, the results of these students will be compared with the new classes of this school.

Keywords: Attitude of Students to the Subject, Active Learning, Performance Motivation

References (2 examples of it)

- [1] Wentzel, K. R. and Brophy, J. E. (2014) *Motivating Students to Learn*, Routledge, New York, US, ISBN 978-0-415-89352-7
- [2] Hrabal, V. and Pavelková, I. (2010) *Jaký jsem učitel (What Teacher am I)*, Portál, s.r.o., Prague, CR, ISBN 978-80-7367-755-8

Silent video task in physics education

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Communication skills belong to the important competences which are used not only by teachers of physics but also by all the people in their everyday life [1]. Therefore, it is important to develop these competences. One of the options how to do it, is including a silent video into the tasks for physics students at various levels of education. Students are asked to comment the silent video that shows some physical phenomenon or experiment. The presentation includes a definition of a silent video, the method of evaluating it, the videos recorded for our survey, and the analysis of the comments noticed by the students who watched the videos. The results of the survey suggest that a silent video could be included in the courses for physics teachers and it is beneficial to them. The silent video was originally designed as a mathematics' task for high school students [2]. We see the possibility of using it also at physics high school education. We believe that silent videos could not only develop verbalization of ideas, but also provide a space for thinking about a physical problem, develop the formulation of hypotheses and research's results, and thus develop the science process skills.

Keywords: silent video, physics education

Acknowledgements:

This work was supported by Project VEGA no. 1/0396/18.

References

- [1] Herényiová, G., Martinčeková, I. 2015. Rozvoj komunikačných zručností. [online] Bratislava: Metodicko-pedagogické centrum, 2015. 48 s. ISBN 978-80-565-1010-0. Available online: https://mpc-edu.sk/sites/default/files/publikacie/herenyiova_martincekova____rozvoj.pdf, [quoted 2019-09-26]
- [2] Hreinsdóttir, F. Kristinsdóttir, B. (2016) Using silent videos in the teaching of mathematics. [online] In Ceretkova, S. (Ed.), Staircase to Even More Interesting Mathematics Teaching, pp. 157-164. 2016, Nitra, Slovakia: Constantine the Philosophers University in Nitra. Available online: <https://goo.gl/e9bnFn>, [quoted 2019-09-26].

Interaction of virtual and real environment in general chemistry education

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As a virtual environment, the internet provides more and more support for chemistry teaching and learning. One of the useful means to increase the understanding in teaching and learning chemistry seems to be dynamic computer models or computer simulations. These means can help students learn better about all three levels of chemical knowledge – microscopic, macroscopic and symbolic.

Dissertation project will be aimed to research on optimization and evaluation of the use of thematically selected computer simulations in chemistry teaching and learning. We assume that the implementation of this means in chemistry lessons can promote educational situation based more on constructivist paradigm and can facilitate understanding the concepts of acid-base and redox reactions on all three levels of chemical knowledge.

In the research we expect the use of a combination of research methods eg. observation, pedagogical experiment (including pre-test, post-test and retention test) in chemistry lessons at secondary school as well as exploratory methods of pedagogical research to find out the teachers' interest in teaching selected topics and their innovations through ICT implementation. Based on the research results, we plan design pedagogical scenarios of chemistry lessons with the support of computer simulations only or in combination with the corresponding real chemical experiment (design-based research).

Keywords: chemistry teaching and learning, computer simulation, acid-base reaction, redox reaction, design-based research

References

- [1] Bell, Randy L. & L. K. Smetana. Using Computer Simulations to Enhance Science Teaching and Learning. Bell, Randy L., Julie Gess-Newsome a Julie Luft. Technology in the secondary science classroom. Arlington, Va.: NSTA Press, 2008, 23-32. ISBN 9781933531274.
- [2] Bílek, M. & V. Machková. Web-based Simulators Applied in the Pre-graduate Teacher Training. In: IGIP 2013. Piscataway: IEEE, 2013, s. 1-4. ISBN 978-1-4799-0152-4.
- [3] Bílek, M. et al. K virtualizaci školních experimentálních činností – možnosti a meze využití jejich kombinace v počáteční přírodovědné výuce. Hradec Králové: M&V, 2011. ISBN 978-80-86771-47-2.
- [4] De Jong, T. & W.R. Van Joolingen. Scientific Discovery Learning with Computer Simulations of Conceptual Domains. Review of Educational Research. 1998-01-01, roč. 68, č. 2, s. 179-201. DOI: 10.3102/00346543068002179. Dostupné z: <http://rer.sagepub.com/cgi/doi/10.3102/00346543068002179>

Results of a pedagogical experiment to verify the role of motivation in different types of chemistry teaching approaches

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Inquiry-Based Science Education (IBSE) is one of the programs science education, which has its positives and negatives. To avoid the negatives of IBSE, could it be enough to apply just some elements of BOV incorporated in to the traditional, conventional education? So we decided to study the role of motivation and an attractive topic in IBSE.^{1,2} The pedagogical experiment was realized and a comparison of inquiry-based science education and traditional teaching with attractive topic/motivation was organized. In the research part, there are shown the results of pedagogical research - we measured students' knowledge of contents and skills and popularity of the teaching of the natural sciences. The pupils achieved similar results in the control and experimental groups.

Keywords: attractiveness of the topic, inquiry based science education, pupils' motivation, PISA

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References

- [1] Kane, E. m. (2013) Urban Student Motivation through Inquiry- Based Learning. *Journal of Studies in Education*, 3(1), pp. 155.
- [2] Čtrnáctová, H.; Čížková, V.; Hlavova, L.; Řezníčková, D. Dovednosti žáků v badatelsky orientované výuce chemie. *Aktuálne trendy vo vyučovaní prírodných vied*. Trnava: PF Trnavská univerzita, 2012.

Context-based approach to teaching Physics at a secondary medical school

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Physics is one of the school subjects of the general education at secondary medical school. The main function of this kind of school subjects is preparing the students for the vocational secondary education. In the educational process in the field of Physics at secondary medical schools we focus on topics closely related to the vocational part of the education and the practice in a specific field of study, it means putting the context-based approach to teaching in practice. [1] This is precisely the issue we deal with in the first part of our contribution.

In the second part of the contribution, we present the results of the survey, that we conducted with students of the secondary medical school. The main aim of the survey was to find the most attractive context for the pupils regarding teaching Physics and whether this context agrees with the school's specialization. Furthermore, we deal with the issue of building the connection between Physics and the vocational education. The aim of the survey was to recognize a certain change in pupils' attitude towards the school subject of Physics when implementing activities, which use the context of the particular field of the vocational education.

Keywords: Context-based approach, Secondary medical school, vocational education

References

- [1] Ministerstvo zdravotníctva Slovenskej republiky (2013). *Štátny Vzdelávací Program Pre Odborné Vzdelávanie Na Stredných Zdravotníckych Školách V Študijnom odbore 5358 M zubný asistent*. Bratislava: Ministerstvo zdravotníctva Slovenskej republiky. Available online: <https://lnk.sk/KS05> [quoted 2019-10-16].

Identification of Students' Ideas and Arguments by Solving Tasks from Physics

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Child is in contact with the outside world since his childhood and it is exploring this world with his senses. Based on these suggestions, it creates the first ideas, finds explanations and formulates arguments. Teachers encounter these ideas during lessons. The student, with the help of the teacher, should rebuild these ideas to scientifically correct ideas, which are able to back up adequate arguments. Argumentation, as a part of communication, is a used part of every single person's life.

During the studies, firstly we were dealing with students' ideas in teaching physics. We created a test, which was focused on the students' ideas from primary school about concepts and phenomena in thematic unit Hydrostatics. We gave this test to the students of elementary school in two countries – in Slovakia and in Hungary. Afterwards we evaluated and compared their answers.

During the analyse of students' answers, we realized, that quality of their answers is not the same in the term of content, neither in the term of the form. Because of that, we have decided, that in dissertation thesis we would evaluate answers of students from earlier mentioned test in the term of argumentation. Firstly, we discussed the theoretical background of argumentation. In the next part of dissertation thesis, we found out the state of students' abilities to argue in solving problems of physics. In this part, we evaluated answers of students from the test as well, but in this case in the term of argumentation. Then we quantified the students' answers and compared the results by grade and country.

Comparing the results of students from different countries, then analysing the differences and finding their causes could create the basis for designing the strategy and progressing to develop argumentation abilities of students in teaching physics.

Keywords: teaching of physics, primary school, argumentation

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The formulation of students' hypotheses in physics education at grammar school

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As an integral part of physics education, we consider the development of students' science process skills. The one of the aims of our survey is the development of students' selected science process skills – predicting and formulation hypotheses in physics education at grammar school on the age level 14 – 16 years. To meet such a goal, we prepared and included in physics lessons 3 specially designed activities aimed at acquisition of students' hypotheses. The process of preparation of specific activities we described below. In the second part, we present one of the specific activities *Friction Force* aimed at acquisition of second students' hypotheses, our experiences with utilization of the activity and students' hypotheses. We discuss clarity and deepness of students' argumentation and we assess students' hypotheses by Hypotheses quality scale.

Keywords: science process skills, formulation hypotheses, physics education.

Teaching chemistry for students with dysfunctions

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Chemistry is considered by students to be a problematic subject. He causes particular difficulties, among others students with dysfunctions.

In order to find the optimal methods and forms of work for students with psychological and pedagogical counseling dysfunctions, research was conducted.

A comprehensive 5-year study focused on working with students with specific learning difficulties (diagnosed by the Psychological and Pedagogical Counseling Center) in chemistry lessons. The study was conducted from two main issues for teaching and learning chemistry: chemical reaction equations and chemical laboratory. In addition, complementary studies were also carried out on another student with learning difficulties in the same areas. Based on them, one topic was chosen (which gave good results for both students) and it was decided to check on a larger group of students with various dysfunctions. This topic concerned imaging of chemical reaction equations.

Research on this topic was conducted on a group of students with various dysfunctions, from different schools, and the classes were conducted by various teachers. The aim of the study was to check whether materials prepared during the case study for the examined student are also possible to be used by other teachers to teach other students with other dysfunctions. The null hypothesis assumes that the materials prepared during the case study can also be used by other teachers in the case of other students with educational difficulties. The article compares the results obtained during the comprehensive research by two students and describes the results of other students' research on one selected topic.

Keywords: ICT, dysfunctions, specific learning difficulties

Conception of dissertation thesis: Inquiry based science education of atom and its structure to the pupils at lower secondary level (ISCED 2)

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Many measurements and studies prove that educational results of pupils and their interest in science are decreasing. One of the ways which seem to be helping to improve the situation is inquiry-based science education focusing on knowledge as well as science process skills. The aim of our dissertation thesis is to prepare didactic reconstruction of atom and its structure. Thesis will consist of several steps – textbooks analysis, study and analysis of misconceptions, presentation of proposed sequence of activities for pupils and its verification on selected sample of pupils and schools.

Keywords: IBSE, atom, atomic structure

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References

- [1] Čáp, J., & Mareš, J. (2001). *Psychologie pro učitele*. Praha: Portál.
- [2] Čtrnáctová, H., & Bílek, M. (2015). Didaktika chemie: vývoj, současný stav a perspektivy. In Stuchlíková, I., Janík, T. et al. (2015). *Odborové didaktiky: vývoj – stav – perspektivy*. Brno, Česká republika: Masarykova univerzita.
- [3] Held, E. (2014). *Induktívno-deduktívna dimenzia prirodovedného vzdelávania*. Typi Universitatis Tyrnaviensis.
- [4] Held, E. a kol. (2011). *Výskumne ladená koncepcia prirodovedného vzdelávania (IBSE v slovenskom kontexte)*. Trnava: Trnavská univerzita v Trnave.
- [5] Held, E. a kol. 2019. *Koncepcia prirodovedného kurikula pre základnú školu 2020*. Trnava.
- [6] Maňák, J., & Knecht, P. (2007). *Hodnocení učebnic*. Brno: PAIDO.
- [7] Orolínová, M., & Kotuláková, K. (2014). *Rozvoj spôsobilostí vedeckej práce v podmienkach kontinuálneho vzdelávania učiteľov*. Trnava.
- [8] Petlák, E. (2016). *Všeobecná didaktika*. Bratislava: IRIS.
- [9] Prokša, M., & Held, E. a kol. (2008). *Metodológia pedagogického výskumu a jeho aplikácia v didaktikách prírodných vied*. Bratislava : Univerzita Komenského v Bratislave.
- [10] Průcha, J. (1998). *Učebnice: Teorie a analýzy edukačního média*. Brno.
- [11] Rocard, M. a kol. (2007). *Science Education Now: A Renewed Pedagogy for the Future of Europa*. Brussel: European Commission.
- [12] Turek, I. (2014). *Didaktika*. Bratislava: Wolters Kluwer.

Preparation of the CLIL Course Content and Its Verification in Pre-gradual Education of Future Science Teachers

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The increased demand for bilingual education has resulted in a growing need for professionally and linguistically qualified teachers whose shortage is evident in most Slovak schools. As science subjects form a major part of bilingual school curricula, we have realised that the specific pre-gradual training for prospective bilingual science educators is inevitable. Our idea was reinforced by our pre-research into perceptions of future science teachers concerning foreign languages and prospective teaching bilingually. Despite concerns and unease in bilingual teaching such as emotional dissatisfaction, difficulty and uncertainty, the prospective teachers still consider it beneficial and valuable with up to 40% of students claiming their interest in teaching science in a foreign language.

As a result, we decided to provide the students of the teacher training programme at the Faculty of Natural Sciences, Comenius University in Bratislava with an optional course for teaching science in a foreign language – a CLIL course. Our current research deals with the planning and preparation of the CLIL course content which is the central topic of my conference presentation. Based on the semi-structured interviews with the participants and a method of semantic differential carried out at the beginning and the end of the course, we would like to verify the significance of the CLIL course in pre-gradual education of future science teachers. The assessment of CLIL-based teaching materials prepared by the course participants will also be the part of the research.

We believe that this research could bring a positive response particularly among the teacher candidates combining science subjects and a foreign language. Moreover, this new course could also eliminate student uncertainty, enhance their zest for science teaching in foreign languages and minimise concerns about delivering bilingual education.

Keywords: bilingual education, science, CLIL, future teachers

Collaborative Learning: Exploring the Outcomes of an Alternative Teaching Technique in Teaching English Grammar at Secondary School Level

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Mastering English grammar is still one of the important components in mastering English. Teachers' teaching technique not only influences students in understanding and applying English grammar but also their motivation in learning English grammar. Unfortunately, many English teachers still use conventional technique which means they just explain the sentence pattern as lecturing. The reality in the classroom shows that there are many English language learners who have difficulty in mastering grammar. Nowadays, students' collaboration in classrooms is becoming an essential part of learner-centred classrooms for their development of lifelong transferable learning skills.

This presentation will present some of the results of a research project exploring collaborative learning as an alternative technique in teaching English grammar at the secondary schools in Yangon, Myanmar.

This presentation will focus on an experimental research using pretest-posttest control group design, which is one of the true experimental designs. 120 Grade 8 students from two secondary schools in Bahan Township, Yangon Region, have been participating with the researcher while practical teaching. Before practical teaching, a pretest is conducted to measure their basic knowledge of English grammar. Using systematic sampling method, subjects are divided into two groups: experimental group and control group based on their pretest scores. Therefore, sixty students are included in each group. The experimental group is exposed to collaborative learning method whilst the control group is taught through traditional method. After treatment, a posttest is conducted to measure students' achievement in learning English grammar.

The aim of the research project has been to explore the outcomes of collaborative learning as an alternative technique in teaching English grammar at the secondary school level with a special focus on the effectiveness and benefits. Based on the research, this presentation will discuss the challenges and opportunities faced in the language education, the benefits of collaborative learning, and how to foster innovation in the modern language classrooms.

The analysis of data has revealed that there is a significant difference between learning outcomes of students who are taught through collaborative learning method and that of traditional method in teaching English grammar. Moreover, results show that the use of collaborative learning strategies helps students achieve a better understanding of English grammar concepts. Although this research has been focusing on English Language Teaching, conclusions can be drawn also for other subjects such as Natural Sciences and Social Sciences.

Keywords: collaborative learning, learner-centred, secondary schools, traditional method, innovation

Working strategies of students in treatment of educational texts

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The success of Czech students in the international PISA survey focused on science literacy has a decreasing tendency. These surveys, using complex tasks to evaluate scientific literacy of students, require more skills, broader knowledge and application skills than just theoretical knowledge of the subject of task. One of the key factors for the successful solution of the problem can be the understanding of text and assignment of tasks, mainly due to the existence of a number of technical expressions and foreign words in commonly used in science and mathematics.

There are also typical graphical representations in the natural sciences, i.e. the connections of texts with graphs, figures and diagrams. The general understanding implies the strategy used by the pupil for solution of the task, as well as the pitfalls that the pupil may encounter during the task, which are not necessarily related to the scientific nature of the task.

Eye tracking can be prospective method for identifying students' strategies for solutions of the task. Using this method it is possible to find out what the pupil is most interested in (Area of interest), what he / she focuses on or, vice versa, which parts of the text or pictures were difficult to grasp for him. Naturally, this method can be used to follow the pupil's specific strategy in solving a task quite comprehensively. With respect to that, this contribution is focused on presentation of several ways of using Eye Tracking to address science-based complex tasks and some of the main aspects and outcomes of the selected Eye Tracking surveys.

Furthermore, the results of the first orientation survey carried out in case of 3 students of general grammar will be presented.

Keywords: eye tracking, learning texts, text task, understanding the text

Pupil's misconception of photosynthesis and respiration concepts

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Misconceptions often arise in pupils' learning, which is why this issue is currently a discussed topic. In biology, we find concepts [1] which by their abstractness, are difficult for pupils to understand and they are often a source of misconceptions.

Such concepts include the subject matter of photosynthesis and respiration, which are also confirmed by many of our and foreign research. The paper presents results of the findings of misconceptions on research sample of students of grammar school in Bratislava identified by the method of phenomenographic interview according to the methodology of Osuská, Pupala (1996) [2]. The basis of the interview are questions proposed in terms of the importance and uniqueness of photosynthesis, the definition of photosynthesis, the course and processes of photosynthesis and respiration. The questions are not exhaustively defined, but are based on the individual situation and reaction of the pupil. The research was conducted in two phases, before and after the transposition topic photosynthesis and respiration. The aim of the second phase was to verify the persistence or occurrence of new pupils misconceptions. Based on the identified misconceptions, we have designed strategies and didactic approaches that will be used as a tool to eliminate and prevent the formation of misconceptions about studied concepts.

In the dissertation thesis "Educational reconstruction of photosynthesis and respiration at grammar school", the identification of misconceptions of the examined concepts is supported by a two-tier test according to the methodology of Haslam and Treagust [3]. Many misconceptions created by wrong and inaccurate interpretations of the concepts which lead to misconceptions are rooted in pupil's knowledge structures and their removal requires a specific approach [4]. As a tool to prevent misconceptions of the concepts examined, we chose practical activities based on an inquiry-based science education.

Keywords: misconception, photosynthesis, respiration, phenomenon interview

References

- [1] Nagyová, S. (2016). Miskoncepce žiakov z oblasti biológie. In Held, L. (Ed.) et al. *Východiská prípravy prírodovedného kurikula pre základné školy 2020 – I. K aktuálnemu stavu prírodovedného poznávania*. (pp. 106-135). Trnava: Typi Universitatis Tyrnaviensis.
- [2] Osuská, L., Pupala, B. (1996). „*To je ako zázrak prírody*“: Fotosyntéza v žiakovom poňatí. *Pedagogika*, 46, pp. 214-223.
- [3] Haslam, F., D. F. Treagust, (1987). *Diagnosing secondary students' misconceptions of photosynthesis and respiration in plants using a two-tier multiple-choice instrument*. *Journal of Biological Education*, 21(3), pp. 203-211.
- [4] Held, L. et al. *Výskumne ladená koncepcia prírodovedného vzdelávania. IBSE v slovenskom kontexte*. Bratislava: Vydavateľstvo TYPI Universitatis Tyrnaviensis, 2011.

The Relationship between Principal's Transformational Leadership Styles and Teachers' Job Performance in Selected High Schools in Monywa Township in Myanmar

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“Effective leadership” can influence school’s success. This study focused specifically on the effect of transformational leadership style of principals on teachers’ job performance. The purpose of this research is to study the relationship between principal’s transformational leadership style and teachers’ job performance in selected High Schools in Monywa Township. This study was conducted by descriptive research method. Two instruments were used to collect the data. “Multifactor Leadership Questionnaire (MLQ)” developed by Avolio, Bass and Jung (1995) was used to measure the principal’s transformational leadership style. To investigate the teachers’ job performance, the researcher generated a questionnaire based on Kim and Richard (1991)’s items of “Performance of Teachers”. Data was analyzed by descriptive statistics and the bivariate (Pearson) correlation of the variables through SPSS software. The findings of the study indicated that the teachers from selected High Schools in Monywa Township asserted that their principals often practice all dimensions of transformational leadership style to manage their schools. In addition, it was found that the teachers from selected High Schools were highly performed all factors of job performance such as “Teachers’ Attitude”, “Subject Mastery of Teachers”, “Teaching Methodology” and “Personal Characteristics”. Therefore, the level of overall job performance of teachers in all selected high schools falls under the high performance level. When studying the relationship between principal’s transformational leadership style and teachers’ job performance, it was found that these variables were highly correlated at the 99% confidence level. Result ($r=0.662$, $p<0.01$) indicated that a high and significant relationship existed between principal’s transformational leadership style and teachers’ job performance in selected High Schools in Monywa Township. The study will help providing guidance and direction to principals who wish to exercise their leadership on a more appropriate and relevant way particularly in a context of change.

Keywords: Transformational leadership, Teachers’ job performance

References

- [1] Avolio, B.J., Bass, B.M. & Jung, D.I. (1995). Multifactor leadership questionnaire: Technical report. Redwood City: Mind Garden.
- [2] Kim, E.C. & Richard, D.K. (1991). A Resource Guide for Secondary School Teaching. Published by Macmillan publishing company, New York.

Initial Findings on the Continuing Professional Development Practices of TVET Teachers in Kenya

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Technical and vocational education and training are vital for the social economic development of societies. This necessitates that the technical and vocation education and training (TVET) provided be of high quality and relevant to the learners and the wider society. However, the quality and relevance of TVET in many parts of the world, and Kenya in particular, remains low. In Kenya, challenges in TVET have been attributed, in part, to the lack of effective continuing professional development by TVET teachers. However, studies investigating actual continuing professional development practices by TVET teachers and the factors that underlie those practices are rare. This study therefore sought to investigate current continuing professional development practices by TVET teachers in Kenya and the underlying reasons that lead to the observed practices.

The results of the pilot study presented in this article are part of a wider study to investigate CPD practices by TVET teachers in Kenya and identify policy proposals to institutionalize effective CPD. After outlining the pilot study and characteristics of the respondents, the article will present initial findings identifying the most common CPD practices reported by the surveyed teachers, motivation and benefits of CPD obtained and challenges. An analysis of the interactions between respondent characteristics and their practices, benefits and challenges will then be presented. The article will conclude with recommendations, focusing on both the main study and TVET teacher CPD.

Keywords: TVET, Effective Continuing Professional Development, Teachers, Kenya

Review on Students' Learning Styles and their satisfaction in learning

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In the entry of this paper focuses on the review of different articles and research regarding the learning styles of the students and their satisfaction in learning. From their own way in particularly how individual different and individual learning which it can make them comfortable, preference in learning and satisfaction. For learning style would acknowledged that students have different learning styles, likewise, these model have been mentioning such as Visual, Auditory, Read/write and Kinesthetic (VARK) learning styles, Kolb learning style inventory and Dunn and Dunn school-based learning style are mentioned. The specific purpose is to present the concept of learning style, to acknowledge the importance of the inventory for analyze the students' learning style, to know how students' satisfaction in their way of learning, to identify benefit of knowing students' learning style. This paper aims at general students in the higher educational without specification of any stream and the overall, this is the most useful for my future research paper in the field of learning styles of students at different fields, genders and nationalities.

Keywords: Learning Styles, Learning Satisfaction.

Assessment of science process skills in discourse of teachers involved in the project ExpEdícia – skús, skúmaj, spoznaj

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There are several projects in Slovakia trying to change the approach in science education at primary schools by introducing constructivist elements into teaching. As an example, the project ExpEdícia, is currently being piloted at selected primary schools. The aim of the project is to create a school environment that inspires pupils to discover, experiment and to learn the basic concepts of the surrounding world. The aim of the paper is to find out how teachers involved in the project ExpEdícia perceive objectives of chemistry education, how they implement them and what is the goal in their pupils' work during chemistry lessons. Data for the analysis are collected from semi-structured interviews consisting of questions about science process skills, the way of their presentation by teachers, their development and application. We also focus on benefits and difficulties of implementing inquiry-based teaching and learning as well. Our next objective is to find out preferred teachers' forms of pupils' assessment and their frequency. Teachers involved in this project seem to be familiar with the objectives listed in the State Educational Program, recording the perspective and importance of this approach for pupils today. Compared to wider sample of in-service teachers who prefer mostly traditional (deductive) way of teaching, ExpEdícia teachers use more accurate expressions related to inductive teaching. Despite the fact that knowledge is still being assessed, teachers increasingly focus on acquired pupils' competences, which they consider difficult to assess. The results obtained from the analysis will be used to develop an instrument to assess science process skills.

Keywords: inquiry based science education, science proces skills, assessment

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References

- [1] Held, Ľ. et al. (2011). *Výskumne ladená koncepcia prírodovedného vzdelávania (IBSE v slovenskom kontexte)*. Trnava: TYPI UNIVERSITATIS TYRNAVENSIS.
- [2] Hendl, J. (2005). *Kvalitatívny výzkum (Základní metody a aplikace)*. Praha: Portál.
- [3] Lapitková, V. et al. (2015). *Spôsobilosti vedeckej práce v prírodovednom vzdelávaní*. Bratislava : Univerzita Komenského v Bratislave.
- [3] Orolinová, M., & Kotuláková, K. (2014). *Rozvoj spôsobilostí vedeckej práce v podmienkach kontinuálneho vzdelávania učiteľov*. Trnava: TYPI UNIVERSITATIS TYRNAVENSIS.
- [4] Prokša, M., & Held, Ľ. et al. (2008). *Metodológia pedagogického výskumu a jeho aplikácia v didaktikách prírodných vied*. Bratislava : Univerzita Komenského v Bratislave.
- [5] Silverman, D. (2005). *Ako robiť kvalitatívny výskum*. Bratislava: Ikar.
- [6] Strauss, A., & Corbinová, J. (1999). *Základy kvalitatívneho výskumu*. Brno: ALBERT.
- [7] Vališová, A., & Kasíková, H. et al. (2007). *Pedagogika pro učitele*. Praha: Grada.

Quality Assurance: National Solutions - Hungary and Germany

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Quality Assurance (QA) has aligned with Bologna Process mid- 1990s that supported changes in the creation of new systems of quality and it was strengthened some trends, such as, internationalisation, institutional autonomy, democracy, and massification of the Higher Education (HE) systems. This paper works with the current movements and challenges to implement quality assurance in Hungary and Germany, hence we use the comparative perspective to explore the differences and similarities between both countries and their national solutions, at the same time we look at systemic functions that they play, and meanings that are carried. This PhD research aims to analyse how quality assurance in HE system is conceived in the official documents that regulated the 3 Germany States - *Länder* (Bavaria, Berlin and the Baden Württemberg States) and also in the Hungarian Higher Education Act (Act CCIV of 2011 on National Higher Education). Methodologically, we used the document analysis that allowed us to search for similarities and differences of the subject European countries concerning the quality assurance policies enacted in Germany and Hungary. We selected those documents to be analysed: Bavarian Higher Education Act of 23 May 2006; Berlin Higher Education Act of 26 July 2011; Baden Württemberg Higher Education Act of 7 March 2018; and the Hungarian Higher Education Act (Act CCIV of 2011 on National Higher Education). The data showed the discourses of Higher Education law in both countries that each country follows a different approach. Hungary Higher Education system is centrally regulated and supervised by the Hungarian government. This centralised legislation indicates a lack of organisational autonomy of the institutions to implement their programs, manage resources, which reflects in the restricted freedom of the teachers in their pedagogical activities due to the strict governmental control. In contrast to the Hungarian context, the German Higher Education system is primarily decentralised, defined by the States and the data collected reveals the commitment to guarantee the personal freedom of the teacher as a fundamental key to the quality assurance. The documents analysed express discourses that guarantee the quality, self-management, gender-equal opportunity and endeavour institutions' autonomy. This promotes quality assurance and provides for improvements in teaching and learning and enhances and expands the Higher Education system.

Keywords: Quality assurance, Regulation of Quality assurance in Germany and Hungary, Higher Education, Comparative study.

Museum Didactics and its Implementation in Chemistry Education

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The dissertation project aims to analyze the possibilities and limits of using expositions of science and technology museums in the teaching and learning processes of chemistry as a general subject. In the first phase of the research process obstacles preventing greater connection of museum exhibitions with the education process will be identified and investigated. Special attention is paid to teaching and learning chemistry at lower and upper secondary schools. Exploratory methods will be used for this phase of the research process. Exploratory methods include questionnaires and interviews with teachers, museum staff and other related institutions. Document analysis is included too. Based on the results obtained from the first phase of the research, proposals for museum excursions with orientation to chemistry education will be created. Finally, the proposals will be evaluated in the pedagogical practice.

Keywords: chemistry, general education, museum didactics, science and technology museums

References

- [1] Beneš, J. Nové zahraniční zkušenosti s výchovou mládeže v muzeích. *Muzejní a vlastivědná práce*, 1973, roč. 11, č. 1, str. 31 – 44.
- [2] Bílek, M. a kol.: *Muzejní didaktika přírodovědných a technických předmětů*. Hradec Králové: Gaudeamus, 2009.
- [3] Bílek, M. Dětská muzea jako integrální součást primární přírodovědné edukace. In Ligas, Š., Gašparová, M. (eds.). *Odkaz kulturneho dedičstva v primárnej edukácii – zborník vedeckej konferencie*. Banská Bystrica: PdF UMB, 2009, s. 22 – 26.
- [4] Bílek, M., CYRUS, P., SLABÝ, A. Muzejní didaktika a výuka chemie. In: Nesměrák, K. (ed.). *Current Trends in Chemical Education*. Praha: PFF UK, 2008, s. 43 – 46.
- [5] Colburn, A. Learning Science Beyond the Classroom. *Science Teacher*. Vol. 75 Issue 5, 2008, p. 10.
- [6] Domenici, V. The Role of Chemistry Museums in Chemical Education for Students and the General Public. *Journal of Chemical Education*. Vol. 58, No. 10, 2008, pp. 1365 – 1367.
- [7] Henry, A. C. The Art Of Science. Chemical Heritage Foundation Takes a New Approach to Science Museums. *Chemical and Engineering News*. Vol. 86 (43), 2008.
- [8] Jůva, V. *Dětské muzeum. Edukační fenomén pro 21. století*. Brno: Paido, 2004.
- [9] Šobáňová, P. Plánování edukačních aktivit muzea. In *Základy muzejní pedagogiky: Studijní texty*. Brno: Moravské zemské muzeum, 2014, s. 58 – 76.

Interactive lessons with ICT in chemistry education

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The development of interactive technologies and other web-based applications allow teachers, nowadays, to present various types of chemistry lessons. In science education, computerized modelling and animations are used for describing, explaining, and predicting scientific processes. These transitions may promote higher order thinking skills, reasoning and explanation abilities which are fundamental for the learning of science [1].

In this paper, we focus on the creation and verification of interactive chemistry lessons for lower secondary schools with application of different interactive methods related to the use of Information and Communication Technology (ICT). Interactive lessons allow the students to clarify, complete and systematize the knowledge they acquired during the lesson, thanks to the way they can rouse their interest and stimulate their intellectual abilities.

The first stage of our work consisted of an analysis of educational content. Whereas little has been written about the benefits and application of interactive lessons. Some possibilities and practical value are considered in works [2-4]. Currently, ICT is able to increase motivation, promote personalized learning and stimulate interaction between teachers and students [5-6].

In the second stage of our work, we developed interactive chemistry lessons for lower secondary schools. First verification was carried out in December 2018 on specialized school-board information technologies in Karaganda (Kazakhstan). The total 52 respondents participated (20 female adolescent and 32 male adolescent). The results showed that more than 75 % of the student enjoy working in an interactive environment and this positively affects their opinions towards the subject. In the next part, we will therefore focus on verification of the use of interactive chemistry lessons in the Czech Republic.

Keywords: interactive lesson, lower secondary school, teaching chemistry

References

- [1] Barak, M., & Dori, Y.J. (2009). Enhancing higher order thinking skills among in-service science education teachers via embedded assessment. *Journal of Science Teacher Education*, 20 (5), pp. 459-474.
Last, First M. *Book Title*. City: Publisher, Year of publication
- [2] Aslam, M., & Kingdon, G. *What can teachers do to raise pupil achievement?* The Centre for the Study of African Economies: University of Oxford, 2007
- [3] Scherwerdt, G., Wuppermann, A. C. (2011). Is traditional teaching all that bad? A within-student between subject approaches. *Economics of Education Review*, 30(2), pp. 365-379.
- [4] Traykov, I., Galcheva, P. (2017). Implementing Interactive Teaching Methods for 9th Grade Organic. Chemistry Classes. *Acta Scientifica Naturalis*, 4 (1), pp. 118-123.
- [5] Kinash, S., Brand, J., Mathew T. (2012). Challenging mobile learning discourse through research: Student perceptions of Blackboard Mobile Learn and iPads. *Australasian Journal of Educational Technology*, 28(4), pp.
- [6] Falloon, G. (2015). What's the difference? Learning collaboratively using iPads in conventional classrooms. *Computers & Education*, 84, pp. 62-77.

Creation of interactive animations and their use in practice

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This contribution presents the creation and verifying of the interdisciplinary interactive educational animations. The animations were created in order to support the teaching at secondary schools and high schools and to connect the knowledge and the skills in chemistry and biology. The authors of many research studies as well as the creators of the state educational strategies claim that nowadays a transition from a traditional way of teaching to the activating methods is needed [1, 2]. Furthermore, these methods should emphasize a pupils' positive relation to the interdisciplinary nature of the learning content [1, 2, 3]. A survey examining the state of learning of the Digestion in human body topic was realized in 2018 in the Czech Republic. The questionnaires were filled in by approximately 150 secondary and high school chemistry and biology teachers across the whole country. On the basis of the results, this topic is perceived as interdisciplinary by the majority of the teachers, however, there is a lack of materials (f. e. animations) promoting its implementation into the both subjects equally. Thus, an educational animation was created in Adobe Flash Professional CS6 programme and afterwards verified using a pilot study. The animation consists of 26 subanimations which concern the chemical and biological nature of the topic of digestion in human body. In total 30 secondary school pupils participated in the pilot study. They were divided into the control group (that was taught in a traditional way) and the experimental group (where the learning process was supported by using the animation). According to the results of the pilot study, the pupils in the experimental group were more motivated while working with the animations and also achieved better study results than the pupils in the control group.

Keywords: Interactive animation, Pupils' motivation, Interdisciplinary relations

References

- [1] Škoda, J., & Doulik, P. (2009). Vývoj paradigmat přírodovědného vzdělávání. *Pedagogická orientace*, 19(3), 24-44.
- [2] Hejnová, E. (2011). Integrovaná výuka přírodovědných předmětů na základních školách v českých zemích – minulost a současnost. *Scientia in educatione*, 2(2), 77-90.
- [3] Janík, T., & Stuchlíková, I. (2010). Oborové didaktiky na vzestupu: přehled aktuálních vývojových tendencí. *Scientia in educatione*, 1(1), 5-32.

Possibilities and Limits of CLIL Use in Chemistry Education: Action Research by Implementation of Chemistry Contents in German Language Lessons

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Content and language integrated learning (CLIL) represent any dual-focused educational context in which the additional language is used as a medium in the teaching and learning of non-language content. It is dual-focused because attention may be predominant on either subject-specific content or language [1]. Dissertation project using the case study approach [2] is focused on the integration of chemistry and German language teaching. For this combination of school subjects there is only a limited number of teaching materials available. Therefore, we are devoting ourselves to creating, validating and optimizing suitable CLIL materials and activities according to design-based research [3] methods. The materials and activities will be optimized based on their usability in practice and on teachers' preferences. Dissertation project is in a phase of evaluating and interpreting the results of an action research [4], which was focused on the implementation of science- (mainly chemistry-) oriented experiments into German language teaching in the 9th class of the lower secondary school. The action research was focused on changes in popularity of foreign languages (especially German) and science subjects (physics, chemistry and biology) among learners after the inclusion of CLIL elements in the teaching. It took the form of a cross- arrangement of the pedagogical experiment in two language groups. The popularity of mentioned subjects was mainly investigated by repeated questionnaire surveys and analysis of learners' portfolios.

During the action research, it turned out that pupils found the implementation of chemical experiments and other chemistry-oriented topics in German language teaching interesting. The results showed a positive change in popularity of German language among pupils. However, other factors may also have affected this change. This experience of integrating CLIL elements into teaching is a good starting point for our next steps.

Keywords: CLIL; Teaching Chemistry and German Language; Case Study; Design-Based Research; Action Research

References

- [1] Marsh, D. (2002). *Content and Language Integrated Learning: The European Dimension - Actions, Trends and Foresight Potential*. Jyväskylä: UNICOM, Continuing Education Centre.
- [2] Gerring, J. (2007). *Case study research. Principles and practice*. Cambridge: Cambridge University Press.
- [3] Elleđerová, E. (2017). Konstrukční výzkum ve vzdělávání. *Pedagogická orientace*, 27(3), 419–448.
- [4] Nezvalová, D. (2003). Akční výzkum ve škole [Action research at school]. *Pedagogika*, 53(3), 300–308.

The predictors of the academic success

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This paper presents methods of finding out the predictive validity of different types of admission procedures. Based on previous researches [1 - 4], this article presents different views of the definition of the academic success, moreover, it also discusses its possible predictors – average marks at high school, average marks at final high school exams, results in university entrance exam tests and others. The results of the studies are compared one to another, and then summed up in a conclusion which states that using both, average marks at high school and results in university entrance exam tests, predict the academic success better than each of these predictors individually as these predictors complement one another.

Keywords: Predictor, Academic success, Validity of admission procedures to universities, Comparison

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References

- [1] Kožený, J., & Tišanská, L. (2001). Akademická úspěšnost na střední škole: prediktor absolvování studia medicíny. *Československá psychologie*, Volume 1, pp. 1-6.
- [2] Rubešová, J. (2009). Souvisí úspěšnost studia na vysoké škole se středoškolským prospěchem? *Pedagogická orientace*, Volume 3, pp. 89-103.
- [3] Škaloudová, A. Predikce úspěšnosti ve studiu učitelství. Praha : Univerzita Karlova v Praze, Pedagogická fakulta, 2003.
- [4] Žoudlík, J. Příjímací zkoušky na vysokou školu jako prediktor akademické úspěšnosti. Masarykova Univerzita v Brně, Filosofická fakulta, 2009.

Research in the capabilities of ISCED 2 pupils to work with data gained within their physics inquiry

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Our work in the area of didactics of physics focuses on how students work with data collected via their own physics inquiry. We follow up on the partial results by teams of R. K. Sawyer and W. Harlen and works by PhD candidates at FMFI UK that looked at co-invention projects in the context of lower secondary schools and introducing physics concepts. We create learning situations with the Hejny approach to teaching mathematics as a source of inspiration. The work will extend and supplement the “ExpEdícia - skús, skúmaj, spoznaj” pilot study which uses a constructivist approach and research-inspired conceptual framework of teaching physics.

We aim to devise a collection of learning situations geared towards collecting and working with quantitative data, with a particular emphasis on working with graphs and other ways of “mathematisation” of data.

The learning situations mentioned above will be implemented in lower secondary school physics classes. We will track the progress of individual pupils as well as the group as a whole in terms of their ability to work with data. Effectiveness of the devised learning situations will be assessed.

Keywords: working with graphs, inquiry-based learning, physics education, science education

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References

- [1] Harlen, W. (2015). Working with big ideas of science education. *Trieste (Italia): Science Education Programme of IAP*.
- [2] Kováč, M. (2019, May). Co-invention Project in the Physics Curriculum on the Lower Secondary School. In *INNODOCT/18. International Conference on Innovation, Documentation and Education* (pp. 13-21). Editorial Universitat Politècnica de València.
- [3] Kuřina, F., & Hejný, M. (2015). *M. Dítě, škola a matematika*.
- [4] Sawyer, R. K. (Ed.). (2005). *The Cambridge handbook of the learning sciences*. Cambridge University Press.
- [5] Velanová, M. M. (2015). Zavádzanie fyzikálnych pojmov v gymnaziálnom vzdelávaní.

Development of experimental design skills (*plenary lecture*)

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Tried and tested ways of active learning, including inquiry approaches, have to be applied in schools to develop the students' scientific literacy. Therefore these should be taught to pre-service and in-service chemistry teachers. With this intention in our mind we have been looking for possible effective introduction of inquiry-based learning in chemistry. In our earlier empirical research [1] established 'step-by-step' instructions were modified to practical activities requiring one or more steps to be designed by the secondary school students. The results suggested that many 14-15 years old students benefited from the intervention. The longitudinal study to investigate the effectiveness of the approach for younger students and over a period of time took the form of a four year research project that began in September 2016. 920 students have been involved, who were 12-13-year-old in the beginning of the study. The impact of the intervention on the students' experimental design skills, disciplinary content knowledge and attitude toward chemistry is measured by structured tests. Five pre-service chemistry teacher students have also been involved in the research, as part of their theses work. The intermediate results have been built in our pre-service chemistry teacher education. Several professional development courses were also organised on this subject by our research group for in-service chemistry teachers.

Since the first school year of the project did not produce the expected results, in the year 2017/2018 and 2018/2019 the student sheets of the experimental groups already contained the main principles and ideas of designing experiments, related to the concrete tasks. For instance, how the 'fair testing' had been applied was explained to the students of one of the experimental groups after they carried out the 'step-by-step' experiments. Meanwhile, the students of the other experimental group were given clues how to apply the 'fair testing' before they had to design the very same experiments. (The control group always gets detailed 'step-by-step' instructions for doing the same experiments.)

The post-test in the end of the second and the third school year showed that the students who had practiced experimental design could correctly design previously unknown experiments more successfully than the students of the control group. The lecture provides the main results of the first three years of the research and how they have been used in our chemistry teacher education.

Keywords: teaching chemistry, inquiry-based, experiment design

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References

[1] Szalay, L., Tóth, Z., (2016), *An inquiry-based approach of traditional 'step-by-step' experiments*, Chem. Educ. Res. Pract., 17, 923-961.

Investigation into Current School-University Practices for Initial Teacher Training in Myanmar

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As knowledge sharing and information processing are rapidly advanced in today knowledge-based society, it is not sufficient to acquire expertise and required knowledge within the scope of one's profession (Tsui & Law, 2007). Especially in teacher training, working alone without collaboration is not enough for the preparation of teachers since there has been a gap between theory and practice in teacher education (Botha, n.d.). To close this gap, collaboration and networking between universities and schools are one of the major solutions to support teacher education.

This article presents the current practices of school-university partnership (SUP) in the preparation of initial teacher training focusing on two teacher training institutes in Myanmar. The aim of the article is to get in depth understanding of current collaboration practices between university, college and schools in order to support initial teacher preparation. Furthermore, the research intends to highlight the need of establishing a strong and successful partnership between schools and teacher training institutes throughout the country. Qualitative method is conducted in this study. Ten participants were interviewed through focus group, formal and informal interviews. Teacher educators' teaching practices and student teachers' peer group teaching were observed by the researcher to see the actual collaboration practices between partners.

The interview results revealed that there is a weak partnership between partners. Schools and institutions are collaborating in a traditional way, focusing on administrative procedures, not for training of student teachers. There is no close relationship and no trust between partners. Observation showed that there will be more effective in teacher training if the school teachers and teacher educators are working together to support student teachers' teaching and evaluation during their practicum. Though peer group teaching by student teachers is a valuable method for preparation of student teachers, the feedback of teacher educators are not supportive enough.

Keywords: School-University Partnership, Collaboration, Teacher Education, Practicum.

References

- [1] Botha, D. M. L. (n.d.). TENSIONS AND POSSIBILITIES IN ESTABLISHING SCHOOL-UNIVERSITY PARTNERSHIPS AS A CORE COMPONENT OF IMPROVED TEACHER EDUCATION. 20.
- [2] Tsui, A. B. M., & Law, D. Y. K. (2007). Learning as boundary-crossing in school-university partnership. *Teaching and Teacher Education*, 23(8), 1289–1301. <https://doi.org/10.1016/j.tate.2006.06.003>

Experience with Implementation of CLIL Method at Primary School

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A current world trend of modern approaches to foreign language teaching implies a creation of an open approach to an implementation of innovative methods, which undoubtedly includes CLIL method (Content and Language Integrated Learning). This method plays a very important role in system of education in Slovakia, especially after the last school reform. Its application is mainly in science and mathematics. It is assumed that a pupil will work actively in the foreign languages. A teacher who integrates the CLIL method into education is required to undertake linguistically, professionally, time-consuming preparation and consultation with a language teacher. The CLIL biology lesson in the foreign language, in our case the English, assumes deeper knowledge of the language of pupils. While teaching the English, it is recommended to reflect the individual learning styles of pupils. Utilizing a wide range of learning approaches enables pupils to achieve better results and at the same time become aware of their own individual learning styles.

In this paper, we focused on a didactic experiment of implementation the CLIL method in science teaching at primary school, specifically in biology. It is important to recognize two types of lessons, which are taught by this method. In the first is used foreign and mother language and in the second is only used foreign language. Many research shows that it is more than important to use the mother language in CLIL teaching. Nevertheless, many teachers prefer to use purely foreign language. The didactic experiment was realized at primary school, where both CLIL methods - the method of using the mother language and the method of using only the foreign language were used. We focused on the English. In parallel, several lessons were taught in two experimental groups of pupils. Before the CLIL testing began, pupils received a pre-test in the English and a questionnaire of 5 questions was also used to determine whether they would be interested in biology lessons in the English. The post-test included the same questions as the pre-test and pupils received the same questionnaire as before, to see if they liked the CLIL lessons and which method was more effective and had higher motivational character for primary school pupils. It was also examined, which method improved pupils' language skills. Based on the evaluated data, we can conclude that lessons of using the mother language were more effective and had higher motivational character for pupils, as was evidenced by other studies, which were carried out in this area. Pupils improved communication skills and acquired better English vocabulary.

Keywords: CLIL method, English language

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How well can students use periodic table of elements after graduating from lower-secondary schools? for the 15th International Conference of Doctoral Studies in Field of Education of Natural Sciences

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The effectiveness of chemistry education is influenced, among other things, by access to individual representations of chemical phenomena. The theoretical background can be found in Johnstone [1], who divides the representations into: macroscopic, submicroscopic and symbolic. Effective (chemistry) education involves a balanced amount of transitions between these representations. In addition, tables, graphs, etc. are being used. The relationship between understanding the chemical phenomena and the representations used to explain them makes the representation competence development an important component of chemistry education [2]. The lack of understanding the representations of chemical phenomena can lead to shaping of so-called didactic formalisms – barriers between the educational content and student's understanding. The level of work with individual visual representations can be detected using interviews (e.g. Think aloud TA or retrospective think aloud RTA). However, these methods are burdened by an inaccurate description of the investigator [3]. Therefore, they are often combined with an objective method of eye-tracking, which allows to record the movements of the solver's eyes directly when solving the task [4].

In addition to the intention of the dissertation research, the submitted contribution presents the partial results of the ET study in connection with RTA focusing on students' ability to work with the periodical table of elements. The results show that the reason for the students' failure is ignorance (substitution of the group after the period, or ignorance of the symbols of the elements) and the input misunderstanding due to the inattentive reading.

Keywords: Visual representation, eye-tracking, chemistry education

References

- [1] Johnstone, A. H. (1991). Why is science difficult to learn? Things are seldom what they seem. *Journal of computer assisted learning*, 7(2), 75-83.
- [2] Kozma, R., & Russell, J. (2005). Students becoming chemists: Developing representation competence. In *Visualization in science education* (pp. 121-145). Springer, Dordrecht.
- [3] Tai, R. H., Loehr, J. F., & Brigham, F. J. (2006). An exploration of the use of eye-gaze tracking to study problem-solving on standardized science assessments. *International journal of research & method in education*, 29(2), 185-208.
- [4] Pienta, N. J. (2017). Studying student behavior and chemistry skill using browser-based tools and eye-tracking hardware *Química Nova*, 40(4), 469-475.

Indicators of critical thinking assessment in Physics education

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Critical thinking is nowadays considered to be one of the important aspects of student's individual forming. Based on the State Educational Program for primary schools [1] and also for grammar schools [2], the development of critical thinking and leading students to think critically, using different points of view in problem solving, belongs to the general aims of the education. Physics education should, among other things, help develop abilities to gather and evaluate information, solve problems, justify own methods and procedures, answer questions, make decisions and therefore help to develop student's critical thinking. We summarize different definitions of critical thinking and indicators of its assessment. These indicators can be used at the Physics classes and should help to see what are the strengths and weaknesses of student's critical thinking.

Keywords: critical thinking, indicators of CT assessment

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References

- [1] ŠPÚ (Štátny pedagogický ústav) (2015). *Štátny vzdelávací program nižšie stredné vzdelávanie – 2. stupeň základnej školy*. Bratislava: ŠPÚ. Available online: <https://goo.gl/vxMg3a>, [quoted 2019-09-26].
- [2] ŠPÚ (Štátny pedagogický ústav) (2015). *Štátny vzdelávací program pre gymnáziá (úplné stredné všeobecné vzdelávanie)*. Bratislava: ŠPÚ. Available online: <https://goo.gl/LG8ZcL>, [quoted 2019-09-26].

Analysis of Structural Elements in Lower-secondary Chemistry Textbooks in Czechia

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Textbooks are one of the most important and also most frequently used educational tool. Their influence on education is therefore enormous. To perform optimally, textbooks need to contain certain integral elements which differentiate them to e.g. mimeographed subject matter or encyclopedia. The set of these elements in textbooks are referred to as textbook didactical equipment. The higher didactical equipment a textbook contains, the more didactically suitable it is. In this contribution, four the most often used lower-secondary chemistry textbooks in Czechia were analyzed with respect to their didactical equipment. Also, teachers' opinion about importance of particular structural elements of textbooks were acquired with the use of a questionnaire. Out of 15 provided structural elements, the teachers (n = 387) consider explanatory text, educational illustrations and subject-matter summary to be the most important ones. On the contrary, the teachers consider a vocabulary of terms, explicit educational aims and links to other sources of information the least important - evaluated the importance as. In the analyzed textbooks in Czechia, all the structural elements the teachers consider important are present. On the other hand, the least important elements were found only in some of the textbooks. The results may serve to the publishers and textbook authors, but also for interpretation of educational outcomes once textbooks and the extent to which it is being used in education is taken into account.

Keywords: textbook analysis, intended curriculum, textbook structural elements, chemistry education

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J. SELYE UNIVERSITY

J. Selye University was founded on 23rd of October 2003 through the passing of the law No. 465/2003 on its establishment by the National Council of the Slovak Republic. The act came into force on 1st of January 2004. J. Selye University is the only independent legal entity in Slovakia, which offers academic study programmes to the ethnic minority in their mother tongue, in Hungarian. It serves as a public institution providing education for the Hungarian minority on the highest educational level. The establishment of J. Selye University was not the only significant step in the development of Slovak higher education, but it was also a unique event in the history of the European Union.



The mission of J. Selye University is to offer high priority for quality study programmes at bachelor, master and PhD levels, and to boost research programmes, to preserve and to respect universal ethical norms, to promote the development of harmonious personality, and to ensure freedom of thought and opinion. The university was established to increase the qualification level of the Hungarian minority in Slovakia. Higher qualification levels can create equal opportunities for ethnic Hungarians on the labour market and can decrease unemployment in the regions with significant Hungarian population. The institution can act as a catalyst of social and economic development, as well.



Conference Center of UJS



Statue of János Selye

J. Selye University aims at educating young intellectuals, who can become the pillars of the national community, and whose language skills will enable them to succeed at home and abroad. The university is an institution where multiculturalism, the freedom of thought and opinion, as well as responsibility, human dignity, democracy, creativity, and the originality of academic research, and efficient instructor-student communication are basic principles. Besides providing high quality education the University contributes to the development of science and research by building cooperation with the international network of institutions, and thus providing an opportunity for Hungarian researchers in Slovakia to join international research projects. The J. Selye University is a regional centre of science and research, by taking an active role in economic, social and cultural life of the region.



Faculty of Education



Faculty of Economics



Reformed Theological Faculty

KOMÁRNO

Komárno (Komárom) was a historical town in Hungary situated on both banks of the Danube. Following the World War I, the newly created Czechoslovakia cut the historical, unified town in half, creating two new towns. The smaller part, based on the former suburb of Újszóny, is in present-day Hungary as Komárom (having the historical Hungarian name).

Komárno and Komárom are connected by the Elisabeth Bridge which used to be a border crossing between Slovakia and Hungary until border checks were lifted according to the Schengen Area agreement of the EU.

The majority of the historical and cultural sites, including the town center of the former Komárno, were well preserved and have remained to this day. The county and town halls, the courthouse, the St. Andrews Church, the Danube Museum, and other buildings are examples of some of the many historical structures still standing today. Klapka Square (named after György Klapka, the Hungarian general who defended Komárno against the Austrians in the War of Independence) and the well-preserved remains of the fortification structure, are Komárno's main historical monuments symbolizing both the pride and resilience of this historical important town. The fortification structure includes Old and New fortresses at the confluence of the rivers Danube and Váh, and the bastions from the Palatine's line to protect the city from west and the bastions of the Váh's line to protect the river banks of Váh. Originating from the Austro-Hungarian era, when Komárno and Komárom were one city, there are three additional fortresses on the Hungarian bank of the Danube river, named as, Star (in Hungarian: Csillag), Igmand and Monostor. The *Europe Square* in the center of Komárno represents buildings from all over Europe. The buildings function as shops and restaurants.

(Copied from the website of Komárno)

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