

Charles University – Faculty of Education



20th International conference

**PROJECT-BASED AND OTHER STUDENT-ACTIVATION STRATEGIES
AND ISSUES IN SCIENCE EDUCATION**

XX.

BOOK OF ABSTRACTS

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INTEGRATED STEM EDUCATION AS A MEANS TO IMPROVE SCIENCE EDUCATION: A BLIND ALLEY?

Radu Bogdan Toma

Abstract

Notwithstanding the increasing attention devoted to the STEM acronym in recent years, the research agenda lacks a clear conceptualization of what constitutes STEM education and how it should be transferred to classroom practice. In this sense, STEM has become a major slogan that has gradually monopolized the international discourse related to improving science education curricula. Despite the popularity of this acronym, there are many aspects of the STEM discourse that require thorough scrutiny. In particular, it is important to reflect on (a) its origins and the ideology that underlies such a movement, (b) how it is conceptualized in the literature, and (c) the lack of sound research to support its relevance. Against this background, in this conference, I reflect on the educational and research practices that are being developed under the STEM umbrella, with special emphasis on its origins, the multiplicity of existing definitions and conceptualizations, the problems inherent to its didactic transposition, and the lack of conclusive findings that support its viability and relevance for science education.

Key words: STEM; Science curriculum; Science education

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PROJECT-BASED EDUCATION AND CREATIVE ACTIVITIES IN STEAM LEARNING

Kristóf Fenyvesi

Abstract

STEM and STEAM learning have become widely known and spread in recent decades. By promoting the integration of different school subjects through curricular and extracurricular activities, formal and informal methods, STEM and STEAM learning's pedagogical framework is most often provided by project-based approaches. Project-based education with problem-solving, inquiry-based, and collaborative methods can meaningfully support the design, the process, and the outcome of inter-, multi- and transdisciplinary learning activities. However, more research is required to explore the critical factors of developing students' disciplinary knowledge, skills, and competences and their ability to apply what they have learned in real life. Research results coming from our "STEAMteach: STEAM Education for Teaching Professionalism" and "Kids Inspiring Kids for STEAM" (KIKS) international projects suggest that discussions, reflection "feedback loops" can contextualize the accomplishment of the project-based activities to improve the learning outcomes. Enhancing the impact of collaborative learning in STEAM projects also raises the opportunity for collaborative teaching, which is another under-explored area of project-based education. In the talk, I introduce the lessons learned in STEAMteach, KIKS, STEAMupgrade, STEAMbox, FreeEd international projects supported by the European Commission, and the "Assessment of transversal skills in formal and informal learning environments" project, which we realized in a consortium of three Finnish universities. The talk also will include an overview of the Experience Workshop STEAM Network's project-based activities and the role of innovation and creativity in project-based STEAM activities.

Key words: STEAM; Project-based education; STEAMteach; KIKS

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DESIGNING AN ACID-BASE STRENGTH INTERACTIVE SCREEN EXPERIMENT (ISE): APP DEVELOPMENT FOR UPPER SECONDARY SCHOOL STUDENTS

Rita Krebs

Abstract

Recently, it has become apparent in chemistry education that, in addition to hands-on experiments, simulations and interactive screen experiments (ISEs) are not only a feasible, but in many cases an essential alternative to student experiments. They are especially suitable for presentation of reactions which would be too dangerous, costly or present phenomena which cannot be observed by the naked eye. Whereas numerous simulations, particle models and instructions for experiments exist, there has been a minor focus on combining the two. Our project aims at constructing and evaluating such a combination by designing an ISE. The topic of acid-base strength was used as it is known to be a challenging topic of chemistry education. By integrating a virtual 'magnifying glass', it is possible to model the particle or sub-microscopic level for the students in contrast to the more common approach of showing macro representation accompanied by chemical formulae (symbolic level). This ISE is developed both for iOS and Android as well as in the form of a WebApp. It will be evaluated with the use of questionnaires on university students (N~30). Next steps include an eye-tracking protocol to evaluate the ISE's effectiveness.

Key words: Acid-base chemistry; Interactive screen experiment; App development; Chemistry education

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WHAT IS IT THAT NOVICES DON'T SEE?: AN EYE-TRACKING STUDY ON PROBLEM-SOLVING PROCEDURE

Martina Tóthová & Martin Rusek

Abstract

One of the 21st century key competencies closely linked with science education is problem-solving. To develop these skills in students, teachers must be good problem solvers themselves. The presented study therefore aimed at identifying these skills in pre-service (chemistry) teachers. Based on a pre-test, three students from a group of freshman chemistry teacher students were selected for qualitative part of the study, which involved one chemistry and one general scientific problem task. To analyse their problem-solving procedure, eye-tracking, retrospective think-aloud and semi-structured interviews were used. Students' progress was compared to experts'. The results showed that novices considered chemistry task more difficult, unlike experts, who considered the science task more difficult and complex, however scored better than the students. Students solved chemistry task using memorized facts and omitted support provided in these tasks. Eye-tracking enabled identification of the study subjects' focus on particular parts of the task. Experts focused on relevant parts, whereas novices distributed their focus also to other parts. Results also revealed the strategies the subjects used. Experts used only expansive strategies, whereas novices used also limiting ones. The combination of methods used in this study proved to be useful. The results suggest, there is a need to present chemistry in more variable ways than testing field-specific, separated, memorized information.

Key words: Eye-tracking; Pre-service teachers; Problem-solving; Science

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PROMOTING PEDAGOGICAL SCIENTIFIC LANGUAGE KNOWLEDGE IN UNIVERSITY TEACHER TRAINING

Corinna Mönch & Silvija Markic

Abstract

Language - and thus also the scientific language of chemistry, the Chemish - forms the basis for communication in chemistry classes. To be able to successfully teach Chemish, chemistry student teachers need to develop Pedagogical Scientific Language Knowledge (PSLK) already during their university teacher education program. In the presentation, a seminar unit will be presented which aims to support the development of chemistry student teachers' PSLK. Thus, a seminar unit was developed to (i) sensitize pre-service chemistry teachers regarding Chemish, (ii) provide pre-service chemistry teachers with knowledge about Chemish itself, and (iii) show them and let them try out methods and tools to teach Chemish. The development was based on the model of participatory action research for university teacher teaching. In the presentation the results of the first cycle will be presented, in detail: (i) the structure of the seminar unit, (ii) individual materials and (iii) the results of the evaluation of the seminar unit.

Key words: Scientific language; Chemistry teacher knowledge; University teacher education

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PRIMARY STUDENT TEACHERS' IDEAS ABOUT STEAM LEARNING ENVIRONMENTS AND ACTIVE LEARNING IN THEM

Anssi Lindell, Pasi Nieminen & Terhi Mäntylä

Abstract

Integrative Teacher Education has been applied in primary teacher education classrooms in University of Jyväskylä since 2003. This education has adopted inquiry based approach to reach beyond the traditional learning and teaching based on just subject core contents. In learning science, these efforts have become to inclusion of all the other school subjects with the more common STEM integration of science, technology, engineering and mathematics, to design STEAM education. It aims to learning disciplinary contents in contexts relevant to students in connection with gaining transversal outcomes and generic competences. The method in this course is to get students to learn in and about varied environments, document the learning and design three examples of active STEAM learning, which combines formal and non-formal learning environments. We asked 14 student teachers to draw and explain their ideas of active learning and STEAM learning environments before the project. We analysed the data with regard the context of teaching and learning the STEAM learning outcomes, elements of reaching 21st century skills as well as teacher knowledge and practices, the roles of students, external experts and environments. The student teachers' pre-conceptions of STEAM learning environments will advise us, what kind of issues of learning outcomes, active learning methods and evaluation are needed to emphasize while instructing their designing of goal-oriented non-formal out-of-classroom learning.

Key words: STEAM learning environments; Active learning; Integrative teacher education

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PLANNING LOW-BARRIER PROBLEM-SOLVING CHEMISTRY CLASSROOMS USING THE CHEMDIVE PLANNING TOOL

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Abstract

Regular education classrooms are becoming increasingly diverse. Universal Design for Learning (UDL) is a cross-curricular concept that can make learning more accessible for all students overall. However, the implementation of UDL often causes difficulties in the concrete planning of subject lessons. This is especially true for prospective teachers. The ChemDive planning tool was therefore developed to support the design of accessible chemistry lessons. With ChemDive, (prospective) teachers can systematically implement the UDL in chemistry lessons by using educational functions. A chemistry lesson planned in this way also supports all learners in solving subject-specific problems.

The planning tool ChemDive was evaluated in a university chemistry teacher training course in the master's program. We found that students implement the UDL significantly more extensively with ChemDive. In addition, the implementation of the educational functions correlates strongly and positively with the implementation of the UDL guidelines.

These results will be reported in detail and exemplary educational functions that support the problem-solving process will be highlighted.

Key words: Universal Design for Learning; Accessibility; Diversity; Lesson Planning; Teacher Education Program

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OPENSCHOOLING THROUGH THE EYES OF EXPERTS

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Abstract

Open schooling is a new concept used in policy making based on cooperation between the schools and wider society. Students and teachers in cooperation with other stakeholders are actively involved in solving real-life projects related to important and topical community topics often linked to the environmental sustainability issues like climate change, clean energy or good health and well-being. Based on the think aloud method – retrospection applied to the experts dealing with open schooling projects in the last year we come up with the information about three clusters of barriers – on the students' side, e.g. differences in the degree to which boys and girls are motivated; on the teachers' side e.g. lack of support from school management; and on the community side, e.g. difficulties in finding appropriate community partner. Because such obstacles need to be overcome in order to successfully implement open schooling projects in schools, we convey experiences of experts and schools on how to deal with these barriers.

Key words: Open schooling; Environmental education; Community

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CHALLENGES OF TEACHING INTEGRATED SCIENCE SUBJECTS AT A LOWER SECONDARY SCHOOL

JAKÉ VÝZVY ČEKAJÍ UČITELE INTEGROVANÉHO PŘEDMĚTU PŘÍRODNÍCH VĚD NA ZÁKLADNÍ ŠKOLE

Eva Stratilová Urválková, Michal Blaško & Svatava Janoušková

Abstract

The compulsory schooling in the Czech Republic is provided by the mandatory curricular document Framework Educational programme for Basic Education. School subjects are gathered in educational areas that allow subjects' integration. Biology, geography, chemistry, and physics form the area of Man and Nature, but still, science subjects are traditionally taught separately. Teaching Science as an integrated subject is more an issue of discussion rather than implementation. In our study, we aim to provide information on the perceived barriers to teaching Science from the view of one particular case of a teacher. This teacher had to succeed as a teacher beginner, moreover as a teacher of integrated science subjects. The data from brain writing were analysed and the inductive analysis revealed themes and categories handling e.g. administrative or subject specific obstacles. Naming the barriers and how to cope with them could be relevant for other science teachers. Nevertheless, we believe that the case study can be an inspiration for the transformation towards pre-service teacher education as well as a discussion point for the current curriculum revision.

Key words: Science education; ISCED2; Case study

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MY FRIEND ALZHEIMER MŮJ KAMARÁD ALZHEIMER

Johana Svitáková & Alena Šrámová

Abstract

Alzheimer's disease is a neurodegenerative disease that affects not only the elderly. The basis of the disease is the degradation and disappearance of neurons in the central nervous system. A frequent symptom is forgetfulness and ultimately the loss of self-sufficiency of the individual. During the illness, so-called Alzheimer's changes are manifested, which also appear in other types of illness to which they are closely related. During the pandemic, when the contact of sick people with their relatives was limited, their conditions significantly worsened, which is proof that socialization helps these people. An example of such a disease is Parkinson's disease or Lewy body dementia. This topic is not popular among people, which causes insufficient awareness about it. In homes for the elderly, students and beginners can help to improve their physical and mental condition with various activities. It could help not only in the improvement of the patient's condition but also it can help the medical staff, who are in short supply in nursing homes.

Key words: Alzheimer; Disease; Elderly people; Students; Cooperation

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ELEMENTS OF PROJECT-BASED LEARNING APPLIED TO TEACHING OF PETROLEUM

PRVKY PROJEKTOVÉ VÝUKY APLIKOVANÉ NA VÝUKU ROPY

Michaela Siegelová & Alžběta Opočenská

Abstract

Nowadays, one of the questions we ask ourselves in the field of pupil education is how to approach teaching so that pupils learn as much as possible about a given topic, are able to work with it and apply it further. So how do we structure the flow of lessons to make them as effective as possible? One possible answer to these questions is to incorporate elements of project-based learning. In the current situation, it could be time consuming to change the style of teaching, so we have focused on selected elements of project-based learning in the research presented here. We chose activation elements such as evocation of a topic from a picture, retrieval of information from professional texts and their interpretation or application of theoretical knowledge to solve a real problem. The individual steps of the lesson were structured in such a way that the pupils practised the skills. At the same time, the concepts in the thematic layer of the pupils were expanded. Given the topic, pupils developed cross-curricular relationships. Through particular activation methods, such as group work, pupils developed key competences. The whole lesson was primarily based on pupils' activity. The aim of the research was whether the elements of project-based learning could improve the quality of teaching and pupils' understanding of the topic. At the same time, it was also investigated whether the pupils were able to elaborate their hypotheses or the issue in the project-based learning.

Key words: Project-based learning; Petroleum; Activation

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WHY DOES IT MAKE SENSE TO THINK ABOUT WHAT WE WEAR? PROČ MÁ SMYSL SE ZAMÝŠLET NAD TÍM, CO NOSÍME?

Lucie Hamerská, Lenka Chlumecká & Klára Špísová

Abstract

This paper describes the realization of project-based learning focused on the textile industry in the 9th grade. The activities were organized in one day. In the first part, students are introduced to the topic through tasks. The second part focuses on gathering materials on their own to create an advertisement, which the pupils present in groups at the end. A questionnaire was used to obtain feedback, verifying both the knowledge gained and the change in affective attitudes. The results of the posttest show a consolidation or slight improvement in attitudes and knowledge. Based on the findings of the realization, the content of the instruction was adjusted to make the activities more potential.

Key words: Project-based learning; Textile industry; Second-hand

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PROJECT-BASED TEACHING IN TECHNOLOGY PRE-SERVICE TEACHERS TRAINING

PROJEKTOVÉ VYUČOVANIE V PRÍPRAVE ŠTUDENTOV UČITEĽSTVA TECHNIKY

Gabriel Bánesz & Danka Lukáčová

Abstract

The use of project-based teaching in natural science and technically oriented school subjects at different kinds and levels of school education is of a great importance. Future teachers need to acquire relevant knowledge and skills related to the project creation. Very important is mainly a coherence between the content of the project, its topic, and situations of the real life. Such situation was undeniably also the Covid-19 pandemic, in which face-to-face teaching was carried out under special conditions. The authors in their paper present their experiences with the use of project-based teaching under these conditions. The students were given a project-based assignment to collect objective data related to their working environment (humidity, temperature, noise, CO₂ volume, and physical conditions (students' hear rate and blood oxygenation). These objective data were collected by means of the relevant measurement apparatuses. To collect subjective data, students' opinions, a questionnaire was used. Results of the objective measurements confirmed that none of the monitored factors exceeded its limit values. A comparison of objectively measured values with subjective opinions of students showed, that assessment of work well-being is a very subjective matter. The results of the project are discussed from the point of view of their application in education.

Key words: Project-based teaching; Measurement; Application in education

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PROBLEM-BASED LEARNING APPLIED TO THE TEACHING OF ACIDS AND BASES

METODA PROBLÉMOVÉHO VYUČOVÁNÍ APLIKOVANÁ NA VÝUKU KYSELIN A ZÁSAD

Eliška Solníčková & Tadeáš Matěcha

Abstract

Due to the development of modern technology and the standard of living, education and school methods need to be expanded to include the targeted development of skills that are essential in the 21st century. This requires new approaches and methods, including activities with project elements. Activities with project-based learning elements focus on the activity of the pupils rather than the teacher, thus enriching the traditional way of teaching in the country. There is an emphasis on guided cognition, where the teacher directs and supports the flow of pupils' ideas. Decontextualization is sought through an appropriate combination of activating elements and reinforcement of new knowledge. In this contribution, we present an activity with project elements on pH in primary school chemistry teaching, which is an output of the study of didactics of chemistry at the Faculty of Education, UK. We enrich the thematic layer of pupils in the form of evocative pictures outlining situations of everyday life, experiment and activities focusing on the supply of information and back we target abstraction in the form of complex tasks focusing on metacognitive strategies in the form of discussion. The whole learning situation and the set of activities result in stimulating the learners and provide a more comprehensive view of the issue, thus triggering the learner's initiative to design the project itself via PBL.

Key words: Problem-based learning; Science education; Natural environment; Acids and bases

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HOW WELL DO YOU KNOW THE MOON? – EXAMPLE OF A TASK WITH INTEGRATED EDUCATIONAL CONTENT

JAK DOBŘE ZNÁTE MĚSÍC? – PŘÍKLAD ÚLOHY S INTEGROVANÝM VZDĚLÁVACÍM OBSAHEM

Veronika Rajtmajerová & Lukáš Rokos

Abstract

Based on the content analysis of the Framework Educational Programme for Elementary Education, the topic Space was selected as a potentially suitable place for integrating the content of the educational area Man and Nature, specifically in subjects physics, biology, and geography, and the educational area Mathematics and its Applications. During the analysis of school educational programs and selected textbooks of these subjects, it was found out that pupils meet separately with issues related to the Moon in the individual subjects. Pupils are introduced to the properties of light and their manifestations (solar and lunar eclipses), lunar phases, and gravitational force in physics. Geography focuses on tidal phenomena, movements, and phases of the Moon, and the influence of the Moon movements on life on Earth is explained to pupils as part of the biological curriculum.

The created task respects the principles of integrated teaching and connects knowledge from different areas into a functional whole. The task is intended for 9th graders, who should already have the necessary knowledge from individual educational areas. Alternatively, it can be included in the sixth grade and some of the phenomena discussed can be gradually explained within the task. As part of the paper, we will present the content of the task and the results of the feedback from teachers in service, including the methodological recommendations that emerged from the implementation in practice.

Key words: Integrated curriculum; STEM task; Moon; Science education

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HIGH SCHOOL STUDENTS' PERCEPTION OF SELECTED ACTIVATING TEACHING METHODS

POROVNÁNÍ VYBRANÝCH AKTIVIZUJÍCÍCH VÝUKOVÝCH METOD Z HLEDISKA ŽÁKŮ NA SŠ

Valerie Chvojová & Edvard Ehler

Abstract

Activating teaching methods are important and effective strategies for improving the education processes in natural sciences. Their popularity, however, was reported to significantly differ between teachers and students. In our report we will present the results of the research of students' subjective perception of eleven selected activating teaching methods (brainstorming, guided discussion, snowball method, inquiry-based learning, I.N.S.E.R.T. method, work with text, concept map, mind map, critical thinking method, rounds and CLIL (Content and Language Integrated Learning)). These selected methods were evaluated by the students using an attitude questionnaire created from the IMI (Intrinsic Motivation Inventory) tool. In each questionnaire, students evaluated activating teaching methods in the categories of interest/pleasure, perceived competence, effort/importance, pressure/tension and value/usefulness. For the complex evaluation and comparison of activating teaching methods across all IMI categories, we have introduced an index of subjective evaluation of teaching methods. According to the index, inquiry-based learning was perceived by the students as the most beneficial of all methods, and the critical thinking method as the least useful.

Key words: Activating teaching methods; Inner motivation; High school; Attitude questionnaire

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PROJECT AND PROBLEM-BASED LESSONS IN COMPUTER SCIENCE FROM THE PERSPECTIVE OF 6TH GRADERS IN SLOVENIA: A CASE STUDY

Katja Krecenbaher Mernik

Abstract

Modern learning procedures are an important part of education. In this study, we examine how these procedures, especially project-based and problem-based learning, affect the teaching computer science in 6th grade in primary school. The focus of this case study was to assess the students' motivation, creativity, achieving of set goals, understanding of instructions and methods they used to solve problems they encountered. This is a case study of two groups of students taking different lessons. Students were tasked with programming an application that younger students at the school could use for learning different skills and consolidating their already acquired knowledge. Students were mostly working in pairs. 4 hours of lessons were conducted for each group while being observed by two or three teachers each time. After transcribing all the gathered data, we analysed the information using qualitative research methods, specifically content analysis. The results showed that all students encountered some sort of problem while working on their application. Student collaboration varied. Most of them managed to figure out how to finish their work and two groups finished their application according to the criteria. In the interviews, we gathered different strategies they used for solving the problem and found that many wished to work in groups of three. The case study could be repeated with a different group of students who would work in pairs of their own choosing or in threes.

Key words: Problem-based education; Project-based education; 6th grade primary school; Case study

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PROMOTING STUDENTS' PROBLEM SOLVING SKILLS THROUGH A CONTENT-INDEPENDENT TOOL

Leonie Jasper & Insa Melle

Abstract

Students are confronted with problems not only in everyday life, but also in chemistry classes. To solve problems strategically and successfully, they have to use executive functions. These are necessary, for example, to set goals, develop steps to achieve goals, apply appropriate strategies, plan, monitor, and evaluate their learning. Additionally, studies have shown that students have difficulty recognizing basic concepts or connecting their prior knowledge to new science content. However, profound conceptual knowledge is an essential prerequisite for effective problem solving. The aim of our project is to develop and evaluate a content-independent tool to promote students in their goal-oriented, self-regulated approach that can be used in school practice as a supplement to regular subject lessons. This strategic instrument will be implemented and tested over a period of several weeks in a pre-post design. Among other things, we plan to investigate the effect of the tool on students' competencies in problem solving processes and making connections between different content areas.

Key words: Problem Solving; Executive Functions; Secondary School; Self-Regulation

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THE INFLUENCE OF ORGANIC COMPOUND MODELS ON STUDENTS' PERCEPTIONS

Małgorzata Nodzyńska-Moroń & Danuta Jyż-Kuroś

Abstract

Students find chemistry a difficult subject because in chemical education there are three levels: - macroworld - that is what we see, hear, feel with our senses; - the micro world - the world of atoms, ions, molecules, the world in which chemical reactions take place; - and the world of symbols - that is, the world of summary formulas, structural formulas, models. It is difficult for them to make connections between: what they observe in the world around them (macroscopic properties) and the sub-microscopic world of particles, atoms and subatomic units. Yet in order to make sense of the macroscopic properties, chemists switch to the sub-microscopic scale where they use explanatory models to try and explain their observations. Which is why In teaching chemistry, we use different types of chemical molecule models. But the question arises: are all models correct? Does the use of models lead to misconceptions in students? The research was conducted in the first four years of high school. 70 students took part in the research. Students were divided into four groups of 4-5 people. Each group used a different type of model during the lesson. It was examined whether working with different types of models influences the students' perceptions of the structure of monohydric alcohols molecules.

Key words: Models; Structural formulas; Molecular shape

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OVERVIEW OF CHEMISTRY LAB EXPERIMENTS RESEARCH BASED ON CLEAR LABORATORY ONLINE SYMPOSIUMS

Sohair Sakhnini & Martin Rusek

Abstract

In the last decades, inquiry-based learning has been seen as a promising approach. In this respect, Chemistry Laboratory: Evaluation, Assessment & Research (CLEAR) represents the most focused platform for discussing curriculum aspects of laboratory education. The current overview provides trends in Chemistry Lab Experiments of the last three years of the CLEAR symposia. It aims at mapping all the chemistry laboratory research conducted worldwide focusing on diverse lab skills needed to be acquired by students, based on various inquiry chemistry laboratory research strands presented in CLEAR symposium. Main results show that, different research strands, focused on different laboratory skills, mainly: Practical skills (Hand-on skills), Transferable skills, technical skills. But in each of these skill categories, there was differences in the items included in each of these categories. There was also stress on other skills Therefore, it is important sort out the settings related to each of the lab skills categories, to gain Global uniformity in definitions. One can categorize these skills into three domains of learning which include cognitive, affective and Psychomotor to be achieved in the teaching process. Findings also stressed the importance of providing an interface between schools and university level for building up community practices, effectively design next generation lab experiments skills confounded by content knowledge.

Key words: Chemistry experiments; Chemistry education; Review

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CATEGORIZATION OF TASKS WITH INTERDISCIPLINARY CONTENT IN SELECTED TEXTBOOKS FOR LOWER-SECONDARY SCHOOL LEVEL

Lukáš Rokos, Vladimíra Petrášková, Libuše Samková & Veronika Rajtmajerová

Abstract

Our study presents a categorization of tasks focusing on interdisciplinary relations included in selected science and mathematics textbooks for lower-secondary schools. It is a pilot study of a project aiming at preparing an integrated STEM curriculum. As a part of the study, we analysed materials at all levels of generality, from curricular documents to particular tasks.

In the first phase of the study, an analysis of the Framework Educational Programme for Elementary Education was carried out and places were identified where it might be possible to integrate various educational contents. Following this analysis, a content analysis of selected School Educational Programmes (N = 15) was conducted focusing on different approaches to teaching the topics identified in the previous step. It was found that the topic ‘Dependencies and Data’ from the educational area Mathematics and its Applications is most often reflected in other educational subjects. That finding was the basis for the analysis of biology, geography, chemistry, physics, technical education and mathematics textbooks (N = 24) in which tasks related to the topic “Dependencies and data” with possible interdisciplinary character were searched. Based on the results of the analysis, a task categorization was created according to the rendition, the level of interdisciplinarity, the degree of interconnection of educational contents, etc. Individual categories and specific illustrative tasks will be presented in the paper.

Key words: Integrated task; STEM; Textbook; Categorization

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VERTEBRATE SPECIES KNOWLEDGE BY PRIMARY AND SECONDARY SCHOOL PUPILS

Markéta Pířová & Michaela Horniaková

Abstract

This study will describe vertebrate species identification skills of pupils from the Czech Republic. Data were collected from March till June 2022 via digital research tool. We examined pupils' species knowledge of 22 pictures of vertebrate species from the digital research tool. In addition, we evaluated the influence of gender and ISCED educational level on vertebrate species knowledge. The paper will describe percentage success rate of vertebrate species knowledge of 1224 respondents. The results showed that species knowledge was significantly different based on the educational level. In general, younger students identified animals better than students of higher levels of education. Significant differences were also confirmed between the five classes of vertebrates. Mammals were the best identified class, followed by amphibians, fish, reptiles and birds were the least correctly identified class. While educational level played a significant role for all classes of vertebrates, the results revealed that gender played a significant role only for reptiles. Boys identified reptiles significantly better than girls.

The research is carried out under a project called Determinants of vertebrate species identification skills: a cross-age study. With registration number: DSGC-2021-0169. The student grant is funded under the OPIE project "Improvement of Doctoral Student Grant Competition Schemes and their Pilot Implementation", reg. no. CZ.02.2.69/0.0/0.0/19_073/0016713.

Key words: Biology education research; Didactics of biology; Vertebrate species; Identification skills

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ENERGY LITERACY AS INTERDISCIPLINARY PROJECT

Josef Šedlbauer, David Syrovátka & Martin Slavík

Abstract

Transformation of the energy sector from fossil fuels to renewable sources is a fundamental technological as well as social challenge of the 21st century. As became evident recently, it is also a matter of highest importance for geopolitical security. Securing long-standing public support for energy transformation is a complex task, part of which is school education. While any scientific knowledge gained in the education process has undeniably an intrinsic value, its scientifically sound application on attitudes and actual behavior of the people is not straightforward, namely in complex topics such as energy literacy. The topic must be thus approached in its interdisciplinarity. Within this study, school project was developed and tested, aiming at understanding humanity's dependence on energy, its sources and limits. Student's knowledge and attitudes were evaluated after four months period and compared with the background study in the same age category. Positive impacts and shortcomings of this school project were identified and recommendations are provided for more effective design of project education in energy literacy.

Key words: Energy literacy; School project; Renewable sources

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**LEARNING ACTIVITIES IN THE LESSONS OF CHEMISTRY WITH THE
SUPPORT OF THE BEAKER MOBILE APPLICATION**
VÝUKOVÉ AKTIVITY VE VÝUCE CHEMIE S PODPOROU MOBILNÍ
APLIKACE BEAKER

Milada Teplá & Petr Distler

Abstract

In the contribution, two learning activities will be presented: “It's not metal like metal” and “Flame tests in a mobile phone”, which use the Beaker mobile application. The first activity focused on the reactivity series of metals and the principles that follow from it. The second activity focused on the color of the flame caused by different metal cations. The activities were created in such a way that, based on the observed chemical reaction and the basis of the step-by-step solution of the tasks in the worksheet, the students put forward hypotheses, which they subsequently verify using the Beaker application and draw general conclusions.

The learning activities were evaluated by nine chemistry teachers, who evaluated them generally positively. They rated them as attractive, sufficiently comprehensible for the age of the students, adequately demanding, illustrative, clear, and reasonable in time. The chemistry lesson using the Beaker mobile application was also evaluated by students in the first and second years of grammar school through the semantic differential. The students evaluated the lessons as comprehensible, sufficiently interesting, and valuable. They rated the atmosphere in the class as friendly.

Key words: Mobile apps; Beaker; Activation methods; Chemical education

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OBSERVATION OF YEAST BEHAVIOR UNDER DIFFERENT CONDITIONS - IBE

POZOROVÁNÍ CHOVÁNÍ KVASINEK ZA RŮZNÝCH PODMÍNEK - BOV

Tereza Figelová, Kristýna Pinkasová & Katarzyna Krištofovič

Abstract

Inquiry-based education (IBE) encourages students to find solutions independently and can be a good vehicle for their development. However, it is quite challenging to incorporate this method into teaching. The proposed teaching block is divided into 3 lessons (2 + 1). The proposed teaching block was validated in a primary school in Prague 10. 18 pupils of 9th grade participated in the validation. The first part (independent research) was verified during a two-hour teaching block. The second part (feedback assessment) was conducted the following class period.

A crucible semaphore was used for immediate feedback during the first part, and IMI (Intrinsic Motivation Inventory) items were used for retrospective assessment in the following class. The IMI provided 5 categories of questions that targeted findings in the areas of interest in the activity, perceived concept, usefulness, effort put in by the learner, and feelings of pressure on the learner. Pupils scored each item on the questionnaire from 1 to 7 (1 - completely false; 4 - somewhat true; 7 - completely true). There were complications during the validation process, especially when the pupils had to independently establish hypotheses and formulate conclusions.

The evaluation of the IMI items was as follows: For categories 1-4, pupils answered mostly positively – the average score of the question in these categories was 4.48 points. For category 5 (perceived pressure and stress), the average score was 1.86 points – so pupils tended to negate feelings of stress.

Key words: Inquiry-based education; Science education; Students activation

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**BIOLOGY SUBJECT MATTER: AN ANALYSIS OF THE TOPIC PROKARYOTE
IN LOWER SECONDARY TEXTBOOKS**
VZDĚLÁVACÍ OBSAH PŘÍRODOPISU: ANALÝZA TÉMATU PROKARYOTA V
UČEBNICÍCH PRO ZÁKLADNÍ ŠKOLY

Lenka Jarošová & Karel Vojíř

Abstract

Textbooks serve as material didactic aids that represent the content of the education of a specific subject. They are used both directly in lessons and by teachers for their own preparation. Textbooks present a selection of scientific content and its transformation to make it as accessible as possible to students. For these reasons textbooks play an important role as a potentially implemented curriculum. The aim of the research was to realize a content analysis of selected chapters of Czech textbooks for lower secondary schools dealing with the issue of prokaryotic organisms. A total of nine biology textbooks that currently have a valid approval clause from the Ministry of Education were analysed. The subject of the analysis were scientific terms as structural elements of the content and their subsequent classification. Considerable differences were found among particular textbooks. The highest attention was paid to the issue of the given topic in the textbooks of the publishing house Prodos and Taktik. Only in these two textbooks is an explanatory text focused on the Archea domain included. The topic of prokaryotic organisms is presented mainly from the point of view of their pathogenicity, morphology, and occurrence. Attention is thus focused primarily on descriptive terminology and a negative view of prokaryotes. This can fundamentally influence students' attitudes towards the topic and science as such.

Key words: Textbook analysis; Content analysis; Biology education; Science education; Prokaryotic organisms

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REFLECTIVE JOURNAL AS A TOOL FOR PROFESSIONAL GROWTH REFLEXNÍ DENÍK JAKO NÁSTROJ PROFESNÍHO RŮSTU

Ina Rajsiglová

Abstract

Changes in the concept of education and school mean significant changes in the concept of the teaching profession and preparation for it. Demands on the teacher's ability to analyse their own work, present and substantiate their concept of work are increasing significantly. In the subject Activation methods and forms in the teaching of science subjects, 26 reflective diaries were examined, in which teacher students wrote down their observations during the semester and on the activation of pupils, they monitored how they succeeded in fulfilling the goals they had defined for themselves at the beginning of the semester, what tools can be used to look for ways to a constructive concept in relation to activation. The qualitative analysis of the diaries shows that the students were able to focus more on the pupils, their flexibility, long-term planning and anticipation skills increased. The results of the work show that targeted interventions (including ongoing and regular reflection of practical experiences) lead to the transformation or refinement of original preconceptions associated with individual components of professional self-concept (concept of self in the role of a teacher, concept of a student, concept of teaching). The effect of the implemented interventions is related (a) to a safe and stimulating environment in a stable study group during university teaching and (b) to the development of reflective competencies of teacher students.

Key words: Reflective diary; Professional portfolio; Pupils activation; Transformation of original preconceptions

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PRE-SERVICE TEACHERS' ATTITUDES TO SCIENTIFIC SKILLS POSTOJE BUDOUCÍCH UČITELŮ K VĚDECKÝM DOVEDNOSTEM

Adam Nejedlý & Karel Vojíř

Abstract

Scientific skills play an important role in actively investigating scientific phenomena and facts. However, an understanding of the nature and validity of information obtained from various sources is equally essential. A good level of scientific skills of teachers is a prerequisite for the successful implementation of teaching methods based on scientific reasoning and inquiry. Teachers' attitudes also play a significant role in educational practice. The research aim was to find out how pre-service teachers consider themselves to be competent in scientific skills, how they perceive the importance of scientific skills for pupils and teachers, and how they evaluate university preparation in this area. A multi-item questionnaire using Likert scales was created for the research. 187 students of the Charles University, Faculty of Education in the academic year 2021/2022 in the final phase of the follow-up master's program (ISCED 7) participated in the research. It was found that students consider scientific skills rather important for themselves, teachers in general and pupils. In contrast, students tend not to consider themselves competent in science skills and do not consider university preparation in science skills to be sufficient. These established facts should lead to greater attention in the preparation of future teachers in the field of scientific skills.

Key words: Scientific skills; Scientific thinking; Scientific reasoning; Professional development; Pre-service teachers

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THE INFLUENCE OF THE RESEARCH PROBLEM TYPE ON THE PRE-SERVICE BIOLOGY TEACHERS' SKILL TO SOLVE INQUIRY-BASED TASKS
VLIV TYPU VÝZKUMNÉHO PROBLÉMU NA DOVEDNOST BUDOUCÍCH UČITELŮ BIOLOGIE ŘEŠIT BADATELSKY ORIENTOVANÉ ÚLOHY

Karel Vojíř, Adam Nejedlý & Lucie Hlaváčová

Abstract

Real science is based on the process of gradually discovering new knowledge, which is put into the context of the previous and raises new questions. To consider the real nature of science, it is essential in teaching to emphasize not only factual and conceptual knowledge, but also the process component associated with specific scientific skills. The answer to these needs is the use of inquiry-based learning. For its effective implementation, sufficiently developed scientific skills of teachers are necessary. Therefore, the aim of the research was to find out how pre-service biology teachers solve inquiry-based tasks and what effect the type of research problem included in the solved task has on their solution. Students at the beginning of the follow-up master's degree (ISCED 7) from the Charles University, Faculty of Education in the academic year 2021/2022 participated in the research. Students practically solved two tasks with a descriptive type of research problem and two tasks with a causal type of research problem. To analyse their solutions, closed coding was used and then a principal components analysis was performed. A significant difference was found in the solution of the tasks depending on the type of research problem. Significant differences were found out in the recording of exact data and in the formulation of the answer to the research question: inclusion of variables and exact results, considering conducted inquiry and given type of research problem

Key words: Scientific thinking; Scientific skills; Inquiry-based learning; Biology education

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THE WORK OF SCIENTISTS IN THE DISCUSSION OF PRIMARY EDUCATION STUDENTS

PRÁCA VEDCOV V DISKURZE ŽIAKOV PRIMÁRNEHO VZDELÁVANIA

Žaneta Staníková & Kristína Žoldošová

Abstract

Current research in the field of science education, as well as the results of conducted preliminary research, indicate that the decreasing interest in science does not result from students' lack of interest in science subjects, but the reason for the decreasing interest is that when choosing a further study or career, students do not feel competent to "do science". The aim of the paper is to analyse the feeling of competence in science among primary school pupils, their ideas about the work of a scientist with an emphasis on the pupils' aspirations for a scientific profession. We found that the way science is taught is also reflected in the activities in which students feel competent and self-confident. Pupils are most interested in science when they can carry out research activities based on their own investigative activity. Pupils seem to lack confidence in their own scientific abilities, which probably occurs when science as an identity discourse meets the contradiction of the idea of a scientist as a good, wise and very thoughtful person with the feeling of the pupil himself not feeling competent enough to carry out the profession, the basic elements of which he did not encounter during his science education.

Key words: Primary education; Aspirations in science; Science education

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IMPROVING TEACHING OF PHOTOSYNTHESIS VIA INQUIRY EDUCATION USING MODERN DIGITAL EQUIPMENT WITH OPTICAL OXYGEN SENSOR

Tereza Brčáková, Renata Ryplová & Jan Pokorný

Abstract

The topic of photosynthesis is known as one of the critical points in science education for many reasons and improvement of teaching of this topic seems to be a challenge for science educators around the world. This contribution brings the results of the survey aimed on the impact of teaching activity based on inquiry approach and using new, user friendly digital measuring device with optical oxygen sensor. An impact of this kind of teaching on students understanding of photosynthesis was investigated via pre-test/ post-test experimental design. The attractiveness of different teaching approaches on teaching of photosynthesis was studied as well. The didactic survey discovered some misconceptions in students' understanding of photosynthesis and mostly positive impact of this teaching approach on their elimination. According to the results of this survey it can be concluded that teaching activity based on inquiry approach and students' measurement using optical oxygen sensor have positive effect on students' understanding of photosynthesis and that field experiments using modern digital measuring devices are considered by students as the most attractive way for learning photosynthesis.

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Key words: Photosynthesis; Inquiry education; Experiments; Digitalization in science education

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THE ATTRACTIVENESS OF PH STUDIES IN NON-FORMAL EDUCATION

Małgorzata Nodzyńska-Moroń, Paweł Cieśla, Vladimír Sirotek & Jitka Štrofová

Abstract

Today, the term pH appears frequently in advertisements for cleaning products and food products. Since the beginning of the 17th century, when pH terms such as acid and base were defined, the definition of pH changed. Currently, Sørensen's definition from the beginning of the 20th century is most often used, where $\text{pH} = -\log [\text{H}^+]$. However, many students and teachers find the mathematical notation very difficult to understand. Therefore, in non-formal and formal education, teachers use various methods and techniques of introducing this concept so that the classes are interesting for students.

The attractiveness of classes in the field of pH testing was tested. 5 different methods of pH testing were investigated at two levels of chemical education. The first study involved 54 primary school children (aged 8-10) who had not yet studied chemistry. 60 students of non-science studies participated in the second study. Self-tested, they tested the pH in the laboratory using 5 different methods. And then they evaluated them. The preferences of children and students were compared.

Key words: Methods of measuring pH; The attractiveness of classes; Motivation

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THE USE OF AN ONLINE ESCAPE GAME IN THE TEACHING OF HIGH SCHOOL CHEMISTRY

Irena Chlebounová

Abstract

Escape games are popular among teachers nowadays. This tool can strengthen knowledge, increase motivation and concentrate attention on students activity. This qualitative research is focused on online escape game, which can be used both in distance or present teaching of chemistry subject. The author of contribution invented online escape game for high school students. The pilot version of game was tested with students from 5 classes of one grammar school and afterwards slightly improved according to their reflection. It consists of 10 slides of Google presentations shared through web sites with links to flippity scavenger hunt, to flippity matching game and to wordwall matching pairs game. The chemistry content is concentrated on derivates of carbohydrates. It is designed as repetition tool of organic chemistry, especially on nomenclature. High school students filled reflection questionnaire after finishing the game. The teacher also discussed with them their feeling about the game. Students found this form of repetition as useful and motivating (especially when played in small groups).

Key words: Escape game; Gamification; Distance Education

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HOW DO HIGH SCHOOL STUDENTS USE THE PERIODIC TABLE OF ELEMENTS: PRELIMINARY EYE-TRACKING STUDY

Pavel Teplý, Petr Šmejkal, Milada Teplá & Svatava Janoušková

Abstract

Eye tracking is already an established research method that enables the acquisition of objective data in the social sciences. In recent years, the importance of this method has also been growing in didactic research, including chemistry education.

This study presents research results focused on students' working with the periodic table of elements (PTE). The aim of this research was to find out differences in the ability to use the PTP between high school students admitted to chemistry and non-chemistry science study programmes at the Faculty of Science. The data were statistically processed and evaluated with respect to the independent variables of gender, field of study and graduation in chemistry. The findings of the study were quite surprising. There were no statistically significant differences among the students in their knowledge and skills in solving PTP-related tasks.

The most striking finding was that students admitted in chemistry programmes were not more successful in solving problems than students of chemistry unrelated programmes. Therefore, based on the results of this research we recommend to emphasize the symbolism in the PTP, the periodic law and the laws it implies in high school teaching. The undergraduate curriculum for teaching general and inorganic chemistry should reflect the statistical uniformity found in this study to include repetition of even the basic concepts and laws related to the PTP.

Key words: Eye-tracking; Periodic table of elements; High school; Undergraduate students; Chemistry education

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A DIGITAL COLLABORATIVE LEARNING ENVIRONMENT TO SUPPORT FIRST-YEAR STUDENTS IN LEARNING MOLECULAR ORBITAL THEORY

David Johannes Hauck, Andreas Steffen & Insa Melle

Abstract

High dropout rates are a fundamental issue at higher education institutions. Especially in natural sciences such as chemistry or physics, students struggle with the high content requirements. Quantum physical theories of chemical bonding such as molecular orbital theory (MO) are among the most difficult topics in chemistry classes because they are difficult to visualise and require prior mathematical knowledge that is often not covered in school. Nevertheless, the basics of the theory are already taught in the first semester at some universities. Consequently, there is an acute need for suitable support programmes for chemistry students at entry-level. We have developed, implemented and evaluated such a measure in the form of a digital collaborative learning unit. A central component of this unit is a digital learning environment (DLE), which consisted of interactive learning videos that the students worked on individually. Subsequently, they created concept maps in which they linked central concepts of MO theory. The students' subject knowledge was measured three times: At the beginning of the intervention, after completing the DLU, and after creating the concept maps. Our results show that students improved significantly by working with the DLU, especially if they started with low to medium prior knowledge. The creation of the concept maps had no significant effect on the students' subject knowledge. Key findings will be presented in detail at the conference.

Key words: Tertiary Education; Molecular Orbital Theory; CSCL; Digital Learning Environment; Concept Maps

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E-LEARNING MATERIALS' CREATION AND APPLICATION METHODOLOGY DEVELOPMENT FOR LOWER CHEMISTRY SECONDARY EDUCATION IN LATVIA

Andrejs Zaicenko, Martin Bílek & Mihails Gorskis

Abstract

Study author created an approach with the help of the Uzdevumi.lv platform's editor that provided virtually unlimited opportunity to individualise calculations, solve problems studying chemistry and to realise competence tests. After national class 10 diagnostic test calculation tasks' results analysis downgrade tendency was detected. At the same time students' interest in e-learning platforms for chemistry education is increasing. Author cooperated with 250 students (class 8 and 9) and 10 teachers with different pedagogical experience to research opportunities of ICT tools in performing calculation tasks' solving competence and checking results, principle of memorisation and basics of algorithms for calculation tasks. As the main instrument for methodology the Uzdevumi.lv task editor was used because of the possibility to create calculation tasks with condition variations to increase diversity and individualised approach to each student. By using 3 different algorithms combined with 5 physical quantity calculations 268 tasks and 1722 common variations of tasks were created. Methodology has been tested and evaluated as recommended to use in Latvian schools to increase students' calculation tasks and solving skills in chemistry courses for lower chemistry secondary education level.

Key words: ICT course; Calculation tasks; E-learning

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FIELDWORK IN TEACHING BIOLOGY

Justyna Mikolajczyk & Małgorzata Nodzyńska-Moroń

Abstract

Fieldwork in teaching science subjects, especially biology and geography, are an important element in shaping the skills and attitudes of young people. In a traditional Polish school, lessons are scheduled and last 45 minutes. During this time, the teacher is required to present issues related to the lesson's topic. This model of education is, for logistical reasons, disadvantageous for the organization of fieldwork. It is related to the time constraints, the lack of staff and the reluctance of teachers themselves to organize this type of classes. Nowadays, the COVID-19 pandemic, has caused both unprecedented disruptions and massive changes to education (Zhao, & Watterston, 2021). Due to changes taking place in the world, education should focus on the skills and shaping of students' attitudes, which is repeatedly described in numerous scientific publications. The article presents the research results of biology teachers regarding their opinion about fieldwork. It was analysed how the respondents rated the expected efficiency of fieldwork using the research tool by Chroustova, Bilek and Sorgo (2015).

Most of the respondents emphasized the need to organize biology fieldclasses, with the simultaneous lack of time for them. Such results may indicate the need to change the organization of lessons in traditional schools in Poland.

Key words: Education system; Biology education; Biology teaching; Biology fieldwork

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USING DIGITAL MEASURING DEVICES AND INQUIRY APPROACH IN FIELD EXPERIMENTS - MODERN WAY FOR TEACHING PHOTOSYNTHESIS

Renata Ryplová, Jan Pokorný, Štěpánka Chmelová & Zbyněk Vácha

Abstract

Photosynthesis is considered as one of the most difficult topics in science education by both, teachers and students as well. The results of recent studies have proven, that from teachers' point of view the invisibility of photosynthetic processes and low student interest in plants are thought to be the main causes of low student understanding of photosynthetic processes. Due to rapid technological development in recent years simple, user-friendly and cheap measuring devices for students experiments on CO₂ exchange in photosynthesis are already available. This contribution brings results of the study aimed on the impact of inquiry based field activity using these modern measuring digital device on students understanding of photosynthetic processes and students' attitudes to plants in their environment. Results of the pre/ post- test study showed, that participation at this activity improved understanding of photosynthetic gas exchange and its ecological circumstances and eliminated several traditional students' misconceptions on photosynthesis. Students attitudes to importance of plants in their environment were enhanced after participation in this activity.

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Key words: Inquiry education; Field experiments; Digitalization

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ON THE CHEMISTRY EDUCATION'S "TRIAD OF TERROR" EXORCISM: THE CASE OF BALANCING CHEMICAL EQUATIONS

Martin Rusek & Lucie Hamerská

Abstract

The ability to note down a course of chemical reaction, balance the formula and use it in chemical calculations belongs among chemists' basic skills. Yet, research showed serious inadequacies in these students' skills. Moreover, balancing chemical formulas teaching bears only limited fruit and also demotivates students. A question whether to include such topic in lower- and upper-secondary chemistry basic courses suggest itself. This study was therefore planned to bring more insight and arguments in this field. Based on a chemical calculations and general chemistry conception tests, 11 freshman students were chosen. Eye-tracking, retrospective think-aloud and interviews were used to map their performance on another chemistry concept pre-test and a set of six chemical equations. The students' success is mostly not determined by their chemistry concepts knowledge. The students did not reflect the sub-microscopic representations and merely solved mathematical problems with chemical symbols. From upper-secondary school chemistry, they carried a prefabricated set of steps how to crack chemistry equations without actually being able to consider the corresponding particles' interactions. In addition, they are mostly trained only in balancing inorganic chemistry formulas. The findings suggest this topic needs extra attention and its teaching needs to be reconsidered to provide intended goals as well as make more sense from the scientific point of view.

Key words: Balancing chemical formulas; Skills; Eye-tracking; Chemistry education

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PROJECT-BASED AND PLACE-BASED EDUCATION USING REGIONAL TEXTBOOK

Kateřina Čiháková

Abstract

Virtual Regional Textbook was developed in Muzeum Říčany in collaboration with 10 teachers (<https://muzeumricany.cz/regionalni-ucebnice/>). It was piloted in 2019-2021 (also during Covid-19 restriction) in different schools. It consists of 14 units (usually 16 lessons each) with topics focused on nature and history. It contains teaching materials such as observation sheets, videos, animations, interactive maps etc., most units contain inquiry- based activities. Various pupils' projects such as school exhibition, video, participative budgeting project, gardening and simple activities for nature protection were realized. The aim was to support place attachment and active citizenship, to enhance the knowledge of local monuments, landscape and species and to develop their inquiry skills.

The pupils had difficulties with assigning a research question to the described research in both pretest and posttest. They were struggling with formulating their own research question. Their score for place attachment didn't change, the knowledge of places increased. Pupils were rather successful in realizing the projects planned under supervision of educators.

Educators from Muzeum Říčany currently organized workshops for school staff focused on place-based education using the regional textbook. Participating teachers stated in the questionnaires that they already use IBSE activities and their willingness to do so in future with new teaching materials from the regional textbook.

Key words: Place-based education; School project; Place attachment; IBSE

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DEVELOPING DIGITAL COMPETENCES WITHIN THE FRAMEWORK OF INTERDISCIPLINARY RELATIONS OF NATURAL SCIENCES BY INQUIRY- BASED LEARNING

Pavλίna Hejsková, Adéla Hartlová, Martin Slavík & Pavλίna Hartmanová

Abstract

By inquiry based learning pupils acquire information from the fields of natural sciences. They process these using mathematical operations and statistics in tables. The conclusions are based on the results found. We guide students to critically assess the given values presented on websites, thereby developing their critical thinking and realistic views of the world. The use of Internet resources leads to the development of digital competences. In doing so, they verify knowledge that is often presented as dogma in school teaching practice.

Key words: Inquiry based learning; Digital competence; Science

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PROJECT DOSLECTEP - THE OUT-OF-SCHOOL SCIENCE EDUCATION IN THE INTERNATIONAL PERSPECTIVE

Martin Bílek, Ahmet Ilhan Sen, Tugba Yuksel, Ibrahim Delen, Ozlem Oktay, Marek Skorsepa, Martin Lindner, Jarmila Kmetova, Martin Rusek, Vesna Milanovic & Florian Woithe

Abstract

The Erasmus+ project “Developing an Out-of-School Learning Curriculum for Teacher Education Programs (DOSLECTEP)” was carried out by a team of academics from four European countries (Germany, Czechia, Slovakia, and Turkey). The project aimed at developing a new curriculum following the Bologna Process guidelines which would promote out-of-school education in formal education environments. The modules including learning materials and activities, can be used in out-of-school learning courses in science teacher education programs and secondary schools. The main outputs are an eBook and a curriculum which includes learning modules. The eBook contains a cross-cultural analysis of out-of-school learning in Europe and offers literature for all out-of-school studies, venues, and learning materials used in participating European countries but also others. The curriculum consists of four different modules, moving from the definition of out-of-school learning through a description of different applications in different out-of-school learning environments to examples of applied assessment/evaluation for out-of-school learning. Overall, the modules should combine theoretical information with examples of activities from all four countries (Disaster and Emergency Education Centre in Turkey, Museums and Workshops of Alchemy and Pharmacy in Czechia, Coffee Roastery in Slovakia, and Science Camps as a Holiday Experience in Germany).

Key words: Out-of-school Learning; Project DOSLECTEP; Science Teacher Education

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