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Charles University – Faculty of Education**



International conference

**PROJECT-BASED EDUCATION AND OTHER ACTIVATING
STRATEGIES IN SCIENCE EDUCATION XVII.**

**PROJEKTOVÉ VYUČOVÁNÍ A DALŠÍ AKTIVIZAČNÍ
STRATEGIE VE VÝUCE PŘÍRODOVĚDNÝCH OBORŮ XVII.**

Karel Vojíř, Martin Rusek (Eds.)

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EDITORIAL

Dear participants of PBE 2019,

This year's conference claims several advancements compared to the previous years. Not only is the number of participants the highest in the history of the conference, but also the number of presentations culminates. Development can be also seen in the topics the authors aim at. The trend of placing the students in the centre of the educational process, which has been promoted at the conference since its very beginning, naturally brings richness of approaches the authors chose. PBE 2019 contains the hottest topics of contemporary science education (research) trends.

The title of the conference could easily be changed to *BE as there are papers dealing with not only project-based, but problem-based and inquiry-based topics most of them bringing some evidence-based suggestions. The popular STEM or STEAM conception together with CLIL or out-of-classroom education complete the list of topics the authors contribute to. The authors of empirical papers also use wider variety of research tools. Except for traditional questionnaires and interviews, there are examples of intrinsic motivation inventories, mind mapping, textual analyses, observations, think aloud or even the growing method of eye-tracking being used by the authors presenting at PBE 2019.

Let me wish all the participants a feeling of a time well spent, inspiring presentations, fruitful discussions and many new encounters.

On behalf of the organizing committee,

Martin Rusek

PREDICTORS OF DIGITAL DICHOTOMOUS KEY ABANDONMENT IN BIOLOGICAL EDUCATION AT PRIMARY SCHOOL

Branko Anđić, Andrej Šorgo

Abstract

In many research digital dichotomous keys (DDK) has been proposed as a new teaching tool for improving students botanical knowledge. As with every new educational technology and using of DDK strongly depends on teachers beliefs about it. The aim of this research was to determine the teacher's intention to the abandonment of using DDK in botanical education in primary school. The study was guided by Unified Theory of Acceptance and Use of Technology (UTAUT), continuance theory and expectation-confirmation theory. Empirical data were obtained from 89 Montenegrin teachers, using an online questionnaire. The obtained data were processed by SPSS Statistics 23 tool package. Results of this research indicate the biggest influence on teacher's intention about the abandonment of DDK using in teaching has technical compatibility, perceived pedagogical impact and user interface quality. Among the findings age, gender and teacher training were not influenced the teacher's intention abandonment of using DDK. The research results suggest support for the application of the UTAUT model and continuance theory and expectation-confirmation theory in studying the adoption of DDK in biological education. Further studies on the research model to extend its validity and reliability are suggested in the aim to provide more accurate knowledge about teacher's indention about the abandonment of using DDK in teaching.

Keywords

dichotomous keys; biology teaching; primary education; UTAUT

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TEACHER'S PROJECT AS INITIATION OF STUDENTS PROJECT

PROJEKT UČITELE JAKO INICIACE PROJEKTU ŽÁK

Karolína Bednářová, Martina Šafránková

Abstract

At primary school, we decided to organize a project day focused on the environmental topic waste and the environment. The students participated in an intensive programme for one day. During this day, they were drawn into the problem using several teaching methods (video, work with text, lecture with expert, chemistry experimental part or workshop). The teachers' aim of the project was mainly to assess the effectiveness of learning during this day. We used three mind maps to find out the results. At first, the grade 9 students wrote their own mind map without any introduction to the specific issue. Second mind map was made with the same classes immediately after the project day. Retention "testing" will be carried out with a time lag, which will take place one month after the implementation of the project day. The retention "testing" will be made also via mind mapping. The data obtained from all the stages of the research will be evaluated and interpreted.

Keywords

project teaching; plastic pollution; environment

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RECOGNIZING THE COMPOUNDS OF THE MILK

POZNÁVÁNÍ SLOUČENIN V MLÉČE

Jan Břížd'ala, Jarmila Kučerová, Eva Stratilová Urválková

Abstract

The current trends in science education tend for last decades to student-centred learning approaches that stress besides others competency-based learning and relevant real-world issues. Within the subjects Chemistry and Farming and processing of animals' products at the Agroškola (agricultural secondary school) an interdisciplinary project education was prepared. The activity is focused on identification of milk compounds: the task is to recognize types of compounds based on the previous experience in chemistry laboratory practice. The qualitative analysis comprises proofs for water, calcium, salt, proteins, carbohydrates and lipids. Moreover, the concrete chemistry compound does not have to be determined, the task is to analyse the type and group of the compound. Therefore the simple proof reactions that can be realized in most of the secondary school laboratory were chosen. The next task was a discussion about mechanism and compounds in each performed reaction, such as lactose, casein etc. Students compared results of the practical part of activity with conclusions of the discussion. The results showed that the interdisciplinary education where theoretical findings are associated with practical agricultural issues are for students more interesting and relevant than general experiments.

Keywords

agricultural science; milk

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TIME MANAGEMENT IN PROJECT BASED EDUCATION

Paweł Cieśla, Małgorzata Nodzyńska, Anna Baprowska, Martin Bílek

Abstract

One of the very important aspects of Project-Based Education (PBE) is the process of planning the time, especially when project assumes many long-term activities. The final success of the project or its failure depends on the proper planning of tasks, determining which activities should be carried out first and which must be carried out later. These planning actions have to be done during the preparatory phase of the project, however after recognition of activities that have to be taken in the project. This process is difficult for pupils, especially at lower education levels, because they are not used to holistic and detailed planning. Thus, students should be equipped with a tool that will help them in this area. There are various tools supporting planning the activities in timeframes. One of them, used in various professional projects is the Gantt diagram but it is not commonly used in a school practice. It is why it was decided to check whether primary school students are able to schedule the activities specified in the project with the use of Gantt diagram. The research were carried out among primary school students in grades 7 and 8, aged 12-14. Results of the research are discussed in the paper.

Keywords

project-based education; gantt diagram; time management

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PROJECT-BASED LEARNING AS A MOTIVATING FACTOR - COSMETICS AND SOAPS

Wioleta Kopek-Putała, Małgorzata Nodzyńska

Abstract

Currently, there is often an opposition between what is natural (considered healthy) and chemical (considered poisonous). Most of populations, including many children, are unaware that this division is not real, and that chemical compounds are found all around us. Many people are not aware that we can find the same substances in food, cosmetics, and even in medicines. The aim of the research was to check whether children know the names of substances used in the kitchen on a daily basis and whether they know what their use is (in and outside the kitchen). It was assumed that students know typical food substances and that they know their use for both cooking and making cosmetics. As part of the classes, students studied the physico-chemical characteristics of soaps and cosmetics received from available food products. A practical summary of children's activities was a box full of cosmetics, while the theoretical added value was the increase in students' knowledge of the chemicals present in their daily lives.

Keywords

project based education; cosmetics

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TOOLS FOR ENHANCING INQUIRY AND TEACHER'S LEARNING GOALS VYUŽITÍ DIAGNOSTICKÝCH NÁSTROJŮ PRO VZDĚLÁVÁNÍ UČITELŮ V BOV

Kateřina Čiháková

Abstract

Czech classrooms are rather closed systems where teachers do their job without regular external observation and feed back. In our professional development program *Oborový mentoring v přírodovědných předmětech* (Subject Mentoring in Science) we tried to change this practice in 17 schools. Participating teachers collaborate with external mentors for 18 months to acquire teaching skills in inquiry-based science education. The professional development program consisted of workshops, 3 instructive lessons for steps of scientific inquiry (scientific questions, hypothesis, experiment design, data collection and drawing conclusions), mentor interviews and meeting of participants for sharing practice. We used modified self- diagnostic tools (Tools for Enhancing Inquiry from Fibonacci Project) during professional development program for both self-assessment, lesson preparation and observation. We analysed the relationship between the items scored as being present and absent from observed inquiry lessons, teacher and school characteristics, frequencies of using different skills and the goals set by the particular teacher.

Keywords

professional development program; inquiry-based science education; self-reflection tools; mentoring

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WHAT IS STEM EDUCATION? OPPORTUNITIES AND THREATS

Ridvan Elmas, Murat Akarsu

Abstract

The purpose of this study is to define the STEM educational approach based on an extensive literature review and to determine the characteristics of STEM educational approach related to opportunities and threats to science education. STEM educational approach was originated from the USA and emerged almost around two decades ago. The STEM is more used as a core concept to an integrated curriculum development process. The STEM educational approach uses the six-step engineering design process as a theoretical framework. The STEM curriculum is based on the idea that students can work for small groups in a structured way to the flexible learning environment to design new products and materials to solve a real-life problem in an altruistic context. The opportunities for STEM educational approach is the transformation of human life with technology such as "industry 4.0". The trends related to industry 4.0 require new skills to compete with robots, which can make cooperation and flexible production. The new generation needs to have unique human skills such as empathy, creative thinking, cooperative problem solving, team building and leadership. The most significant threat to STEM educational approach is the dissemination of it with a top-down approach without providing enough support and professional development for teachers, which most of them have background only one of these separate disciplines.

Keywords

STEM; STEM education; opportunities for STEM; threats for STEM approach

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INQUIRY DIARY: STUDENTS' MOTIVATION TOWARD WATER-QUALITY EVALUATION

BADATELSKÝ DENÍK: MOTIVACE ŽÁKŮ K HODNOCENÍ KVALITY VODY

Václav Fiala, Linda Honskusová

Abstract

Inquiry-based learning is an approach which allows students to experience higher levels of autonomy when compared to traditional approaches. It also supports positive attitudes towards science (chemistry) which has been recently decreasing. In this contribution we present a design, verification and modification of an activity chosen from the author-made Inquiry-based Chemistry Diary on the topic of „Water“. The activity was tested during chemistry lessons at two lower-secondary schools with 56 students (3 classes) during October 2019. The activity started with a guiding question raised by a teacher: What kind of water is better to drink - tap water or bottled water? Students were preparing for discussion at home, then at school, each group presented their own arguments. Conclusions of the discussion led to the necessity of checking assumptions in the laboratory. Therefore, next lesson the students made simple analyses of drinking water (bottled and tap) which they had brought. Obtained results were compared by students with legislative-standard for drinking/tap water. The activity proved to be feasible. All groups successfully carried out the analysis (nitrites, phosphates, total water hardness, ferrates) of the brought water samples and they were able to interpret the results correctly. The intrinsic motivation questionnaire (IMI) was used to gain feedback. The students seem not to feel pressure during their activities and they responded positively in the areas of interest/enjoyment, effort/usefulness and value/usefulness.

Keywords

Water; inquiry-based activity; motivation

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DEVELOPING LEARNING ENVIRONMENTS FOR INDEPENDENT WORK

Elisabeth Hofer

Abstract

Inquiry-based science education (IBSE) is a complex instructional approach, which requires a great deal of specific knowledge and skill on the part of the teacher. In order to prepare pre-service teachers to deal with this complexity, it is recommendable to gradually introduce individual aspects of IBSE, such as goals for IBSE, the Levels of IBSE and measures for structuring and guiding IBSE one after another. In this talk, I will present how individual aspects of IBSE are included within the curriculum for pre-service teacher education in chemistry at the University of Vienna (Austria). For this purpose, I will refer to the development of three specific learning environments: units following the 5E instructional model, tasks including scaffolding measures for independent work and interaction boxes including tasks and materials for individual learning. Referring to these three examples, I will discuss both the goals we strive to achieve and the challenges we as well as the pre-service teachers are confronted with when introducing these types of teaching methods.

Keywords

inquiry-based science education; learning environments; independent work

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THE INFLUENCE OF THE COURSE OBSERVATION PRACTICE ON THE STUDENTS' ABILITY TO REFLECT ON THE OBSERVED LESSON

VLIV KURZU NÁSLECHOVÁ PRAXE NA SCHOPNOST REFLEKTOVAT HOSPITOVANOU VÝUKU

Linda Honskusová, Karel Vojíř, Martin Rusek

Abstract

A teacher's ability to reflect on teaching is one of the basic attributes enhancing the quality of educational process. The ability to adequately analyze educational situations by pre-service or novice teachers is essential not only for their future occupational decisions, but also for their own feedback. One way to develop this ability is to deepen their professional vision. This paper focuses on mapping these competencies on pre-service chemistry teachers by analyzing their input and output reflections after attending the Observation Practice course. This approach is one of the typical ways in which the current state of professional vision is mapped. The research was carried out in the winter semester 2018/2019. The participants consisted of pre-service chemistry teachers (N = 12, an available sample) at the Charles University, Faculty of Education in the first year of the follow-up master's program. Respondents of the research individually reflected the video-lesson of one chemistry lesson at elementary school (theme - alkanes) at the beginning and at the end of the course (X/2018–I/2019). Subsequent written reflections were analyzed by a self-constructed tool based on van Es and Sherin's methodology (2009). This was complemented by the Shulman-based model (Pedagogical Content Knowledge (PCK)) and set to the 3A methodology (Slavík et al., 2014) scheme. The results indicate that after completing the course, the students' ability to notice in the "actor" category moved from the teacher himself to describing the micro-situations of the teacher together with the students(s). At the same time, even after completing the course, students are still focusing on general pedagogical phenomena at the expense of subject (chemistry) itself and field-didactic. In the output reflections, the quality of the students' ability to annotate deepened and at the same time a positive shift in terms of attempts to alter teaching situations was observed.

Keywords

pre-service teacher education; teacher professional development

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WHAT REVEALED SELF EVALUATION OF STUDENTS ABOUT THEIR WAY OF SOLVING PROBLEMS IN CHEMISTRY

CO ODHALILA SEBEREFLEXE STUDENTŮ O JEJICH ZPŮSOBU ŘEŠENÍ PROBLÉMŮ V CHEMII

Irena Chlebounová

Abstract

The research focused on high school students in their last year of chemistry education. Its aim was to analyze how they feel confident in solving problems during chemistry lessons. There were questions about the amount of work connected with chemistry also during their free time and about their needs for repetition and so on during chemistry lessons. The study was done at an eight-year grammar school in the center of Prague. The group of 76 (18 – 19 years old) students from five different classes who were in the last year of their chemistry curriculum got the questionnaire with 21 statements and 33 open questions. By using an 11-point Likert scale, they indicated their progress or regress in skills and competencies during last three years of their chemistry curriculum. The open questions gave the students an opportunity to comment on the position of the marks they made on the Likert scale. The students were taught by three different teachers with different teaching styles. Students answers showed a dependence of their confidence on the teaching style of their teacher. Teachers focusing on active learning of students had more confident students compare to traditional transmissive teaching model.

Keywords

solving problems; self evaluation; chemistry education

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AQUAPONIC AS AN EXAMPLE OF SUCCESSFUL STEM EDUCATION

Wenzel Chris

Abstract

In this contribution there is a short introduction of the general term “Aquaponic” and what that entitles. Additionally, the three kinds of Aquaponic systems are introduced and a basic overview is given about the necessary circumstances considering water, plants, fish and bacteria. Furthermore, the execution and necessary parameters of the Aquaponic system in different locations such as a greenhouse or in the Mediterranean climate (eg. in Spain) is explained. Some ideas of researching will be presented, for example to develop a quantitative questionnaire for scientific purposes and evaluations. This way pupil’s motivations for STEM subjects in school can be monitored and evaluated. The time aspect should be further considered about how pupil’s motivation changes over the course of the project. Alternatively, a transcontinental/ international analysis of curricular events in the pupil’s lives could be evaluated. For this, qualitative methods– based on appropriate literature - such as interviews with teachers in different countries (e.g. Spain, Egypt and Germany) can be used.

Keywords

aquaponic; fish; plants; fish farming; STEAM

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PREPARATION OF EDUCATIONAL ACTIVITIES IMPLEMENTED IN THE
PESTICIDES- FREE SCHOOLS WITH A POSSIBLE PROBABILITY COGNITIVE
AND AFFECTIVE RESULTS OF ENVIRONMENTAL EDUCATION OF PUPILS
PRÍPRAVA EDUKAČNÝCH AKTIVÍT V PROJEKTE ŠKOLY BEZ PESTICÍDOV S
CIEĽOM OVPLYVNIŤ VÝSLEDKY ENVIRONMENTÁLNEHO VZDELÁVANIA
ŽIAKOV

Ivan Il'ko, Viera Peterková

Abstract

Short-term and long-term educational activities too, using various forms of formal and non-formal education, are relatively common practice in environmental education. Teachers and researchers often use them for their potential to achieve positive cognitive and affective learning outcomes (Sellmann - Bogner, 2013, Raabe et al., 2018, Boeve de Pauw et al., 2019). According to Stern et al. (2014), the biggest challenge in environmental education is the development of change in proenvironmental behavior and Peterková (2017) has found the same results. There is no problem in achieving a higher level of environmental awareness of pupils, but the involvement and willingness of individuals is very low. The paper is focused on the presentation of the forthcoming methodological manual in the project Pesticides- Free Schools. We focus on concrete theoretical and practical tasks, using constructivist approach in education and active work of pupils, as well as suggestions for excursions with this issue. After applying the guide, we will verify its impact on the sustainable behavior of pupils in schools involved in the project.

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Keywords

pesticides free schools; educational activities; environmental education

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GEOLOGY FIELD TRIP MAKES A DIFFERENCE

VLIV GEOLOGICKÉ EXKURZE NA ZNALOSTI ŽÁKŮ

Vanda Janštová, Boris Poláček, Petr Novotný

Abstract

As many authors point out, geology is not very popular among pupils. Because the relationship to science is related to knowledge and ways how it is gained, we have focused on students' geological knowledge and the possibilities to effectively increase them. We wondered if there would be a difference between the knowledge of the students who took part in the geological field trip and those who learned the same content at school using on-line materials. We prepared a quasi-experiment in which the pupils were divided into two groups. One learned in geological exposition in the premises of the Botanical Garden, Faculty of Science, Charles University and the other worked with identical materials available on the website of the given geological exposition. Significant increase in knowledge has been demonstrated only for pupils attending the geological exposition. Knowledge of pupils working with on-line materials increased only non-significantly. The difference between the increase in the knowledge of pupils from the two groups was significant with a moderate effect ($d = 0.67$). Thus, geological excursions can be a way of combining a popular and effective method with less popular content to achieve a better learning experience.

Keywords

teaching geology; upper secondary school; field trip; outdoor education

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PROGRESSIVE DEVELOPMENT OF THEMES AS A BASIS FOR PROJECT TEACHING: CASE STUDY

POSTUPNÉ ROZVÍJENÍ TÉMAT JAKO ZÁKLAD PROJEKTOVÉHO VYUČOVÁNÍ: PŘÍPADOVÁ STUDIE

Barbora Jeřábková, Karel Vojíř

Abstract

One of the most important and at the same time the most difficult phases of project teaching is its initiation. It is important for pupils to assume their responsibility for their own education at this stage. The aim of this paper is to present a case study of teaching carried out in a group of pupils of the 3rd - 5th grade at elementary school Hůrka in Kutná Hora. Gradual development of topics was used in the lessons. This was based on questions and interest of the pupils, who were given room for their own research and experiment. This not only increased the autonomy of pupils' activities and assumed responsibility for their learning and management, but also the natural acquisition of knowledge in the context. The original content of the lesson, which was working with natural dyes, gradually resulted in several new, related topics of natural science character. The starting point for the development of the topics were the principles of intuitive pedagogy, specifically the pedagogical observation of the pupils' current interests, which set the direction and methods of teaching. Individual teaching steps were analyzed with respect to the theoretical background of project teaching with regard to the activity of the involved participants. In the process of solving, the activity of pupils and their initiative in solving increased. The gradual development of topics seems to be an effective strategy to increase pupils' interest in specific educational content and thus to initiate the project as a pupil's activity.

Keywords

development of topics; project based education; responsibility for learning

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YOU ARE WHAT YOU EAT

JSTE, TO CO JÍTE

Markéta Kantorová

Abstract

In the project, students will learn how to prevent metabolic or lifestyle diseases regarding carbohydrates. They get to know new terminology both in Czech and English connected to the topic of carbohydrates. Based on didactic games and research activities, students learn how the human body digests carbohydrates and about nutrients in food. In the project classes, school subjects of Biology, Chemistry, Physical Education, Civics and Social Sciences are interconnected. Students will work with professional resources; they can also consult the teacher. As a part of the project, students develop their presentation skills and communication skills. In the preparatory phase, teachers prepare texts, activities and necessary tools and chemicals as well as motivational video for students. Teachers also create exact time schedule, designate the course of the project teaching with an option of final evaluation with following discussion. In the implementation phase, teachers play the motivational video followed by questions for the students. After that, a brain writing and mind mapping on the white board follows with an optional help from the teacher. Students work in groups of 4, where everyone has a certain role. The outcome of each group will be demonstrated at the end of the project. There will be a comparison of mind maps created in the beginning and at the end of the project as a proof of a success of the project. In the final phase of the project, students' outcomes of the project are evaluated.

Keywords

diet; physical activity; honey; food; kilojoule

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CALCIUM CYCLE AS A PROPOSAL FOR THE SOLUTION OF THE CRITICAL CURRICULUM OF CHEMICAL REACTION

CYKLUS VÁPŇÍKU JAKO NÁVRH ŘEŠENÍ KRITICKÉHO UČIVA CHEMICKÉ REAKCE

Karel Kolář, Kateřina Chroustová, Veronika Machková

Abstract

Chemical reactions are among the key and critical points of chemistry teaching in lower secondary school. The difficulty of this topic relates to its complexity, which includes a large number of different types of reactions and their inconsistent classification. As part of the solution of the project OP RDE "Didactics: Man and Nature A" focused on the initial curriculum of natural sciences, an innovation of teaching the topic of chemical reactions was proposed in the form of implementation of experimental cycles. By analysing their course, including the classification of partial chemical reactions according to selected criteria, learners acquire knowledge of this issue. Calcium cycles that have a connection with everyday life and do not pose such safety risks as, for example, copper cycles have proven to be most suitable for pupil experimental performance. In this paper, we present a concrete form of laboratory exercise involving a cycle of calcium. The original proposal was first commented by practical teachers and subsequently verified by action research in various regions of the Czech Republic. Teachers received the laboratory exercise favourably, but recommend e.g. the first step, i.e. thermal decomposition of calcium carbonate, to be carried out by the teacher. Based on the teachers' comments, modifications to the laboratory exercise were proposed.

Keywords

chemistry teaching; experimental cycle; calcium cycle; lower secondary education

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ANALYSIS OF THE THEME ATOM AND ITS STRUCTURE IN TEXTBOOKS

ANALÝZA TÉMY STAVBA ATÓMU V UČEBNICIACH

Dominika Koperová, Ľubomír Held

Abstract

The aim of the contribution is to present an analysis of didactic presentation of Atom as particle in selected chemistry textbooks in former and current Czechoslovakian context and neighbouring countries (Germany and Poland). We differentiated the textbooks based on several criteria - the school system level, the science education model, approximation of atom as submicroscopic or/and subatomic level and topics about atom in pictorial material. We evaluated obtained data based on the way content is organized. We also took into consideration its difficulty. Given the diversity of the text in terms of length, we quantified the text (number of words and sentences about the topic), evaluated and compared it with the textbook which represents a different concept of teaching science (based on constructivism). We could conclude that in the selected textbooks, there is increasingly more space for description of the atom and its visual representation, but with no emphasis on understanding of the structure itself which can lead to the pupils' misconceptions. These misconceptions are the matter of our further study.

Keywords

textbook; analysis; atom; atomic structure

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METALS IN PROJECTS

KOVY V PROJEKTECH

Jiří Kubný, Kateřina Trčková

Abstract

The paper provides a proposal for a methodology of the assignment of a medium-term project “There is not all gold glittering”, its pilot verification by 30 pupils of a six-year grammar school and points out the obstacles that arose in introducing this method into teaching. According to mutual sympathy, the pupils were divided into three five-member groups, three four-member groups and one three-member group. Individual groups chose the project theme, one of the “Seven Metal Families”. Each "metal family" included four motivational subtopics: Are you single or in a relationship?, Metal, I'll get you! Noble or plain metal? Being metal is IN! In the preparatory phase, the groups divided their work on sub-themes among the members. At first, the students searched the available information sources, searched for interesting facts, linked and generalized information. The output of this activity was individual posters in A4 format. Outputs were checked by correspondence. In the next step, the pupils prepared a group project of A1 format. Pitfalls identified during the project solution: communication between pupils and student via e-mail, inappropriate timing of the project, time demand in the period of conclusion of the classification. The deficiencies will be eliminated in further verification by pupils of the 9th grade of elementary school.

Keywords

project-based learning; motivation; knowledge-constuction; learning to learn; peer learning.

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STARRING OXYGEN: RESULTS OF THE INQUIRY ACTIVITY PILOT

V HLAVNÍ ROLI KYSLÍK: VÝSLEDKY OVĚŘOVÁNÍ BADATELSKÉ AKTIVITY

Lucie Kuncová, Martin Rusek

Abstract

In this paper, a pilot study of an inquiry activity focused on oxygen is presented. The authors firstly redesigned an activity focused on photosynthesis and breathing into an IBSE shape. Then they piloted it on a group of chemistry teacher students. Based on the changes a course was made for lower-secondary school students. Beforehand, they received a pre-test focusing on their knowledge regarding the two topics. They also received a short questionnaire designed to show their interest in the topics. Based on this, they were divided into groups after coming to the Faculty of Education for one half-day. The groups worked in a twisted pedagogical experiment scheme. They received one task of a traditional nature and one IBSE task scaffolded with tip cards. After doing each experiment, the students filled in a post-test (containing only knowledge related to the experiment) and the IMI questionnaire (dimensions usefulness, interest, pressure and effort). The results show that the developed IBSE activities improved the students' knowledge and were more motivated in several of the of observed categories.

Keywords

inquiry-based activity; oxygen, using sensors, effectiveness of IBSE

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A MOOC FOR TEACHERS TO INSTRUCT PROJECT-BASED FLEXIBLE STEAM -LEARNING IN BASIC EDUCATION

Anssi Lindell, Antti Lehtinen

Abstract

Flexibility in science and mathematics means an ability to apply knowledge and practice in different contexts and to create alternative solutions and evaluate their applicability for the case at hand. Flexibility can be learned by active methods, which includes spontaneous problem solving. We have designed a 2 ECTS MOOC of flexible STEAM learning by project based approach for teachers of grades 1 – 9 as a part of a in-service teacher training development project. One of the main objectives of the course is to make teachers comfortable to leave their classroom with the students to meet different communities of learners and new challenges in flexible learning environments.

The course includes two part. The first part introduces project based learning in multidisciplinary STEAM environments by videotaped presentations, written materials and on-line discussions. The participating teachers also familiarize themselves with a case project via video clips and teaching materials. In the case project, pre-service teachers designed a STEAM project together with their instructors and experts of a science museum. In the second part the participants design, test, assess and report an experiment of a similar project design from their own premises.

The participating teachers' experiences are collected through a questionnaire at the end of the course. Also the projects and the communities of the learners created by the participants will be discussed.

Keywords

flexible; STEAM, project

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EYE-TRACKING AS AN INSTRUMENT TO RESEARCH ON AN SERIOUS ONLINE GAME

Martin Lindner, Chris Wenzel, Nils Kotschote

Abstract

During the recent years online games had been implemented as educational tools in many classes. We are researching on a game dealing with sustainable land use. The first results are promising, but deeper insight into the learning process is expected by using eye-tracking to describe and analyse the process of the use of that game. Eye-Tracking provides a big volume of data, which provides a lot of interpretation options. We are at the beginning of the analysis and we will present some results. They show the change of focus during the game, the adaptation process and the areas of interest of beginners, experienced users and this with respect to the age of the gamers. These data support a further development of the game, which is than deeply based on the results of the survey. After observing the gamers by external persons and after using pre-post-questionnaires in the recent years, this analysis is seen as a serious step into more detailed results.

Keywords

eye-tracking; online-game

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GENETICS IN THE PERSPECTIVE OF CZECH LOWER SECONDARY SCHOOLS: MISCONCEPTIONS AND SOLUTIONS

GENETIKA NA DRUHÉM STUPNI ČESKÝCH ZÁKLADNÍCH ŠKOL: MISKONCEPCE A JEJICH PREVENENCE

Markéta Machová

Abstract

Although genetics is a well-established topic in lower secondary school curriculum (ISCED 2) in many countries, pupils still have difficulty understanding the basic principles of inheritance and hold various misconceptions about it. These problems were already found also among absolvents of Czech secondary schools. In the Czech environment, the origin of misconceptions about genetics is not well-known, so their prevention was not yet effectively possible. Using the analysis of textbooks, a questionnaire survey among teachers and testing the knowledge of pupils, potential risk factors, influencing the pupil's understanding, have been identified. Although teachers are educated in the topic properly and textbooks do not contain major errors, topic of genetics is highly shattered among the implemented curriculum. Therefore, pupils of Czech lower secondary schools have only little understanding of genetics based on rather term-oriented knowledge. They mostly do not understand the role of nucleus and DNA in the living organism. To prevent rise of misconceptions among pupils, simple school lesson modifications (like higher continuity and better didactic transformation of the topic of genetics) are discussed.

Keywords

genetics; misconceptions; pupils; ISCED 2

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“PLASTICS” CAMPAIGN

KAMPAŇ PLASTY

Klára Malúšová, Barbora Kolařová, Adéla Horáková

Abstract

The article aims at a project focused on teaching how to “handle with plastics” in the 9th grade of lower-secondary school. Education is focused on knowledge, skills and attitude aspects. The lesson begins with an up-to-date video of the situation around plastics on the planet. The students are introduced to a model situation in which they become part of an agency, which should try to map and propose a solution to the situation around plastics in Prague 4 (Modřany). Students pass an entry test to make them familiar with their initial knowledge, attitudes and then during the group conversation open up possibilities and specialization to lead the campaign. Afterwards, they will be divided into groups according their own preferences, which they want to devote during the campaign (e.g. advertising, alternative articles, nearby questionnaires, leaflets, advertising, etc.) Following lesson will be divided into groups, outline and specify their work. Students will work independently, under the teacher's guidance. Next part is their independent work outside of the school, where they spend their free time. In the following lesson, students have the space to complete their materials and consult their results with each other or with the teacher. They will present their final results in the last lesson, which will be finished with an output test of their knowledge and attitudes toward the topic.

Keywords

project based education; plastics; lower-secondary education

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IS CLIL IN BIOLOGY THRIVING AT CZECH SECONDARY SCHOOLS (ISCED 3)?

JAK SE DAŘÍ CLILU V BIOLOGII NA ČESKÝCH GYMNÁZIÍCH (ISCED 3)?

Zuzana Marcineková

Abstract

This paper focuses on teachers' application of CLIL in biology lessons in the Czech Republic. The main aim of the study was to determine the extent of teachers' application of CLIL in biology at secondary schools (ISCED 3). This report is composed of two parts. The theoretical part describes CLIL as one of the activating strategy in science education, we characterized four basic components of successful CLIL lesson and we mentioned why it is beneficial to support teaching biology in CLIL. The practical part of the paper consists of an analysis of the results including teachers' responses to particular items in the questionnaire. In this part we focused on the detection of the number of teachers who teach biology at secondary schools and how many teachers use CLIL in their biology lessons. We also emphasized in which teaching forms teachers realize CLIL lessons and we classified concrete teaching units they teach in CLIL in biology. From the facts we found out we made conclusions and recommendations for pedagogical practice.

Keywords

biology; CLIL; secondary schools; teachers; teaching forms; teaching units

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CARBOHYDRATES, OR A CUP OF COOK

SACHARIDY, ANEB HRNEČKU VAŘ

Drahomíra Marešová, Daniel Brabenec, Pavel Palyov, Kateřina Turynová

Abstract

This project dealt with the modern theme of healthy nutrition and the impact of consumption of various carbohydrates on human health. During the project, students learnt terms like carbohydrates, sugars and differences among them, both in chemical and nutritional terms. The students compared various foods containing a high proportion of polysaccharides, which were subsequently split into monosaccharides by varying heat treatment. The results were interpreted with the students in the form of a discussion, which summarized the observed events and new findings on the topic. Finally, the students evaluated the benefit of the project by completing a questionnaire (IMI), comprising a total of 24 questions divided into 4 categories: interest/pleasure, perceived competence, effort/importance and value/usefulness. The survey results show values from average to slightly positive; the mean value of the subscale perceived competence was 4.7, which corresponds more to the average. The effort/importance subscale showed values of 5.1 and is therefore slightly above average. So is the value/utility subscale. Its mean value was 5.3. The result of the mean value of the interest/pleasure subscale (6.1) was above average and most specifically pointed out the internal motivation of the respondents. Overall, this project can be considered to be beneficial in terms of increasing students attitude to own health and interest in the issue.

Keywords

carbohydrates; healthy nutrition; human health; food

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SUMMER CAMPS FOR CHILDREN WITH SCIENCE ACTIVITIES - CONTENT AND EVALUATION

Justyna Mikołajczyk

Abstract

This report describes organization method of Summer Camps for children with Science Activities. Main goal of those camps is spending time active and encourage children to know their ability. Science Activities focus on ecology, environmental Protection and diversity of fauna and flora in Poland. In those activities participate children from each type of Camp. During 1,5 h groups of children (between 10-14 persons) have the chance to understand things like process of composting, ways to care about environment (like recycling or saving water), anthill development cycle. Research equipment such as magnifying glasses and entomological meshes are available for use. Depending on the specifics of the given camp, classes take place with each group at least 3 times throughout the entire camp or children have the option of choosing activities. This paper presents organisation of Summer Camp with Science Activities and children's opinion about this form of learning. Evaluation was taken during 2019 Summer Camps in Poland.

Keywords

sumer camps; science

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ARE THE STUDENTS' RESULTS IN ADMISSION TESTS IN BIOLOGY RELIABLE PREDICTORS OF THEIR FUTURE STUDY SUCCESS?

Jan Mourek

Abstract

The informative value of various types of admission test for university studies is intensively discussed in the Czech Republic and abroad. Until 2015/2016, Faculty of Science of Charles University (Prague, Czech Republic) used a combination of two different admission tests into biological study programs - the knowledge test in biology and the test of general study prerequisites.

The aim of this paper is to evaluate the relation between the students' results in both types of tests and their subsequent study results in the bachelor study. The results of students from five years of admission and their overall study average in the first year of bachelor study were compared. There was a statistically significant but weak correlation between the students' scores in the general study prerequisites test and their study average in the first year. The scores in the biology admission test correlated with the study average moderately and this correlation was even stronger than if the scores in both tests were pooled. The results of the admission test in biology quite well reflected the later student outcome of the state bachelor's examination, while in the case of the general study prerequisites this relation was not significant. Therefore, the knowledge test in biology seems to be a more suitable way of selecting good students than the general study prerequisites test or than the combination of both tests.

The research was supported by the Charles University project UNCE/HUM/024

Keywords

biology; bachelor study; admission tests; study results

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TWELVE-YEAR MASTERS - RESEARCH WORKS OF GRADUATES OF WADOWICE CHILDREN'S UNIVERSITY

Małgorzata Nodzyńska

Abstract

As a part of non-formal education, the Children's University of Wadowice (ChUW) has been operating for 5 years. At the end of 5 years of education, students could receive a master's degree. To this end, they had to choose the topic of their work and conduct research.

In the year 2018/2019 an experiment was carried out intended to verify whether young students are able to independently carry out all the activities that are necessary to write a master's thesis and what benefits (defined here as an increase in knowledge, skills) will bring their activities. Only 12 students applied to receive a master's degree ChUW. These students for 5 years attended classes to the ChUW, and participated in 75 classes on a variety of topics. The pupils had to select one of these topics and on the basis of them create so-called graduation thesis. In reality, the successive stages of the ChUW students thesis preparation corresponded exactly to the next steps in the method of projects. Master's theses were evaluated by a team of university professors and experts from the fields of data. During their work, students completed a questionnaire that examined the increase in knowledge and skills acquired by the student during the project. Test results show the level of maturity and independence in the implementation of student projects.

Keywords

non-formal education; project method; IBSE

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ASSESSMENT OF SCIENCE PROCESS SKILLS IN DISCOURSE OF IN-SERVICE TEACHERS

SPÔSOBILOSTI VEDECKEJ PRÁCE A ICH HODNOTENIE V DISKURZE UČITEĽOV Z PRAXE

Natália Priškinová, Ľubomír Held

Abstract

The current concept of science education puts emphasis on development of science process skills, since focusing on content seems to be insufficient. The aim of the contribution is to find out how teachers perceive objectives of chemistry education, how they implement them and what is the goal in their pupils' work during chemistry lessons. Using the analysis of semi-structured interviews, we try to determine whether the traditional (mostly deductive) approach is still predominate or the teaching has the features of inquiry based science education at lower secondary level (ISCED 2). Our next objectives are to analyze teachers' ways and forms of pupils' assessment in order to identify the importance of different areas – knowledge, skills and attitudes. The first results suggest that teachers are neither familiar with procedures of inductive instruction and facilitating such learning nor with terms related to inductive teaching. Based on the analysis we conclude that teachers tend to assess dominantly factual knowledge.

Keywords

inquiry-based teaching; science process skills; assessment

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IDENTIFICATION OF SPECIES NAMES ABOUT ORGANISMS IN THE CONTENT STANDARD OF SUBJECT BIOLOGY (ISCED 2) AT PRESENT AND BEFORE THE INTRODUCTION OF SCHOOL REFORM IN SLOVAKIA

IDENTIFIKÁCIA DRUHOVÉHO NÁZVOSLOVIA ORGANIZMOV V OBSAHOVOM ŠTANDARDE PREDMETU BIOLÓGIA (ISCED 2) V SÚČASNOSTI A PRED ZAVEDENÍM ŠKOLSKEJ REFORMY NA SLOVENSKU

Kvasničák Radoslav

Abstract

BACKGROUND: The aim of the research was to analyze the level of pupils' knowledge about species names of organisms discussed in textbooks of biology before school reform (2004/05) and compare to the ecosystem approach of science education at present (ISCED 2).

METHODS: When comparing knowledge of the binomic nomenclature of organisms, the research groups (2004/05: 490 respondents and 2017/18: 520 respondents) used the method of pupil's drawing about ecosystems combined with free-form questions (Cronbach alpha 0,68). The interaction of urban and rural primary schools was also examined.

RESULTS: At present, when comparing pupils' knowledge of the nomenclature of organisms, pupils in 5th grade are on average more successful than pupils in 9th grade of primary schools. Significant differences have been seen at the level of the nomenclature of organisms adopted before and after school reform, with 9th grade pupils following on average more successful (2017/18), than pupils acquiring knowledge about ecosystems in pre-school reform (2004/05). .

CONCLUSION: According to the present results on ecosystems in the current school system we recommend in the future to integrate into the classic teaching of the elements of non-formal science education on the characteristics of ecosystems in the context of the natural environment directly on the school land in the urban or a rural primary school.

Acknowledgments: We would like to thank to the directors, teachers and pupils of the urban and rural primary schools of the Trnava region who have been involved in comparative research on ecosystem teaching in 2004/5 and 2017/18 years.

Keywords

knowledge; species nomenclature; pupil; primary school; school reform

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MICRO-TEACHING AS A STRATEGY OF REAL-LIFE TRAINING FROM THE PERSPECTIVE OF BEGINNING TEACHERS

MIKROVYUČOVÁNÍ JAKO STRATEGIE NÁCVIKU REÁLNÉHO UČENÍ POHLEDEM ZAČÍNÁJÍCÍCH UČITELŮ

Jiřina Rajsiglová, Katřina Přibylová

Abstract

The paper provides an insight into how micro-teaching helped novice teachers in their practice and what recommendation provide the novice teachers to improve this activation strategy. On the example of twelve beginning teachers with whom semi-structured interviews were conducted, we present the positives and negatives of micro-training for real school practice. From the research we concluded, that beginning teacher welcome micro-teaching, yet some have criticized especially its distance from reality. On the one hand, the beginning teacher said, that it is not possible to simulate teaching in a real classroom, because they lack 'real' pupils, and on the other hand, undergraduate students have much more time to prepare micro-teaching than is available in real school practice. Criticism is often conditioned by the way the beginning teacher receives support from the introducing teacher and the school environment, not as much undergraduate preparation as will be presented in the article by means of schemes.

Keywords

micro-teachin; beginning teachers; real school practisel

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GROUP WORK AS A PART OF PROJECT BASED LEARNING: DIFFICULTIES PERCEIVED BY PUPILS

SKUPINOVÁ PRÁCE JAKO SOUČÁST PROJEKTOVÉ VÝUKY: OBTÍŽE VNÍMANÉ ŽÁKY

Jiřina Rajsiglová, Barbora Škarková

Abstract

Group work is one of the teaching organizational forms used in school practice and is an integral part of project based education – teaching and learning. In this article we present the difficulties of group work perceived by pupils, which were revealed in research on project based learning and its implementation in school practice. A semi-structured interview was chosen as a research method that combines the advantages and minimizes the disadvantages of both extreme forms of the interview, unstructured and structured. The grounded theory method was used to evaluate the obtained data. In the survey, 50 pupils from three regions of the Czech Republic participated. Often reported difficulties that pupils accentuated as making their group work difficult, were unequal workload of group members, difficulty in grouping pupils, disciplinary problems, assigning work to pupils in their homework at the expense of solving them at school, etc. The paper also presents what teachers can use to make the group work consistent with the principles of cooperative teaching, which would also facilitate the work within project based education, or prepare pupils for the above mentioned organizational forms of teaching appropriately.

Keywords

group work; project based education; pupils; semi-structured interview; grounded theory

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CHEMICAL CALCULATIONS IN THE CONTEXT OF REAL LIFE AT PRIMARY AND SECONDARY SCHOOL

CHEMICKÉ VÝPOČTY V KONTEXTU REÁLNÉHO ŽIVOTA NA ZÁKLADNÍ A STŘEDNÍ ŠKOLE

Jakub Režňák, Hana Čtrnáctová

Abstract

The purpose of this paper is to present worksheets and recommendations for their application in learning and fixing phase of chemistry teaching. These worksheets contain multicomponent learning tasks closely connected to reality for pupils of primary and secondary school. Tasks are focused on chemical and simple mathematical calculations which are necessary for complex understanding of presented parts of chemistry curriculum. Creation of worksheet was based on analysis of present valid curricular documents, mainly parts focused on chemical calculations. Tasks are related to problematics of sustainable development. Created worksheets were verified and evaluated at primary and grammar school. Pupils also filled questionnaire focused on subjective evaluation of interestingness and difficulty of worksheets. By applying tasks containing chemical calculations to topics of chemistry we can strengthen relevance of presented information, develop quantitative thinking of students and their abilities to think about presented problem complexly and in context.

Keywords

teaching of chemistry; worksheets; chemical calculations; multicomponent learning tasks; sustainable development

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HOW DOES IT TASTE? PRACTICAL TASK FOCUSED ON THE HUMAN SENSORY SYSTEM FOR LOWER-SECONDARY LEVEL

JAK CO CHUTNÁ? PRAKTICKÁ ÚLOHA ZAMĚŘENÁ NA SMYSLOVOU SOUSTAVU ČLOVĚKA PRO 2. STUPEŇ ZŠ

Lukáš Rokos, Lenka Pavlasová

Abstract

Human Physiology is students' favourite subject in Biology education and it allows implementation of various practical activities, for example inquiry tasks. The inquiry-based education is often discussed as innovative way for science education because it promotes students' active involvement in the teaching-learning process as well as the growth of practical activities during the lessons. This paper introduces the inquiry tasks related to human sensory system, specifically combination of single senses in recognizing the taste of selected food. The worksheet for lower-secondary students is in the attachment of this paper. The proposed task has been verified in practice and there is an analysis how students filled the worksheet and their most frequent mistakes. There are also methodological recommendations based on the conclusions from observation during the implementation at selected schools and they are intended to support the teachers who would like to use this task in their practice.

Keywords

inquiry-based education; biology; human physiology; practical students' activities

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STUDENTS' PROBLEM SOLVING SKILLS ENHANCEMENT: RESULTS OF AN ACTION RESEARCH

Martin Rusek, Martina Tóthová

Abstract

In this paper, results of an action research aimed at developing students' abilities to solve science problem-tasks are presented. This is a part of the objectives of science education defined both in the national curriculum and in the objectives of the PISA. To do so, the indicator tasks from the Education standards were used. The research sample consisted of grade 1 upper-secondary school students. At the beginning of the action research, students' achievement in problem-solving was determined and the strategies they used were mapped. This was done in two steps: quantitative – with the use of test results and qualitative - based on eye-tracking and the think-aloud method. The proposed intervention was based on these results. Subsequent chemistry teaching included tasks of a similar type aimed at developing and strengthening expansive strategies for problem solving and eliminating the identified limiting strategies. The ongoing state of intervention was monitored by sub-testing and lesson hospitations. The success of the intervention was tested with the use of tasks of comparable difficulty with the pre-test during and at the end of the research. The post-test results show that the interventions led to an improvement in the students' ability to solve problem tasks. From the original 64% of unsuccessful and 36% of partially-successful solvers, 13% of unsuccessful, 58% of partially-successful and 29% of successful students emerged after the intervention.

Keywords

problem solving; lower secondary education; science education

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FOSTERING INTERDISCIPLINARITY THROUGH TECHNOLOGY ENHANCED
LEARNING OF PLANT TRANSPIRATION
PODPORA MEZIPŘEDMĚTOVÝCH VZTAHŮ A VYUŽITÍ MODERNÍCH
TECHNOLOGIÍ VE VÝUCE TRANSPIRACE

Renata Ryplová, Jan Pokorný

Abstract

Recent studies highlighted low students' knowledge of plant transpiration as well as low ability to understand interdisciplinary relations between physics concepts and plant biology. This illiteracy is highly alarming, because knowledge of such core processes is necessary for proper understanding of ecological function of vegetation in retaining water in our environment. Plants cool themselves by evaporation of water via small valves in leaves (stomata). Transpiration can transfer several hundred watts of solar energy per m².

On the other hand students' favour to use modern technologies is widely known as well as prevalingly positive impact of technology enhanced education on students achievement in science. From this reason a technology enhanced learning unit was proposed and tested in this study to explore its effectiveness. The students worked during the project based education with pc programmed usb sensors for humidity and air temperature and evaluated graphically the data. They were asked to explain the results of the outdoor measurement by known concepts obtained theoretically during biology and physics lessons. An impact of education was tested via a pre-test /post- test experimental design. Based on the findings of this study, discussion and recommendations are provided

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Keywords

transpiration; interdisciplinarity; technology enhanced education

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INTERACTIVE QUIZ GAMES IN CHEMISTRY AS AN ACTIVE TEACHING
METHOD FOR LOWER-SECONDARY STUDENTS
INTERAKTIVNÍ KVÍZOVÉ HRY VE VÝUCE CHEMIE NA ÚROVNI ZŠ A
NIŽŠÍHO GYMNÁZIA JAKO ZPŮSOB AKTIVNÍ VÝUKY

Timur Sadykov, Hana Čtrnáctová

Abstract

An upcoming generation of children has grown up playing games on consoles, mobile phones, computers (including laptops and notebooks), tablets and other mobile digital devices; these are a part of everyday life for young people. They have developed a different set of attitudes, which may have created a disconnection between their expectations and the learning environment found in classrooms. Among multiple variants to resolve this issue, interactive games as one-way of efficient development of teaching process.

Interactive quiz games offer not only relaxation and good feeling of winning but also a possibility of acquisition of new knowledge and computer skills. Competitiveness acts as an extra motivation factor, which makes the process of playing more engaging and fun at the same time.

The goal is to present created and tested interactive quiz games for lower secondary schools, which might not only enrich the educational process and contribute to the development of logical thinking, but also provide sufficient entertainment and distraction. The use of ICT allows teachers to create interactive quiz games in a various programs such as Microsoft PowerPoint or Learning apps, Kahoot.

The first verification in Kazakhstan showed that more than 75 % of students enjoy working with quiz games and this positively affects their opinions towards the subject. In the next part, we will therefore focus on verification of the use of interactive quiz games in the Czech Republic.

Keywords

interactive quiz games; secondary school; student's opinions.

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DATA SHARING IN INTER-SCHOOL RESEARCH PROJECTS

ZDIEĽANIE DÁT V MEDZIŠKOLSKÝCH VÝSKUMNÝCH PROJEKTOCH

Romana Schubertová

Abstract

The paper presents the setting up of project Skúmaj svoje okolie (Explore your surroundings), organized by the Faculty of Natural Sciences of Matej Bel University and supported by the grant agency KEGA. During the school year, pupils of 15 schools take measurements around their school to monitor the environment. The measurements are shared among themselves to answer their own research questions on hydrology, hydrobiology and meteorology. The results of the research are presented at a joint conference. Data sharing, which can serve not only to produce research questions but also to validate them, is currently possible through a number of available (free) applications. A specific solution for the project Skúmaj svoje okolie, which was created using the Google Account platform, can be an inspiration for other similar projects as well as smaller inter-school collaborations. Involvement of experts in the analysis of pupil data and using of them in own researches brings elements of citizen science into the project. The project was created to support the implementation of the GLOBE program in Slovakia.

The project to support the implementation of the GLOBE program in Slovakia was established and is being implemented with the support of the Cultural and Educational Grant Agency of the Ministry of Education, Youth and Sports of the Slovak Republic, KEGA 051UMB-4/2018

Keywords

citizen science; data sharing; environment, education

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CHEMICAL EQUATIONS AND CALCULATIONS FROM CHEMICAL
EQUATIONS - CRITICAL POINTS OF THE INITIAL CHEMICAL CURRICULUM
CHEMICKÉ ROVNICE A VÝPOČTY Z CHEMICKÝCH ROVNIC - KRITICKÁ
MÍSTA POČÁTEČNÍHO CHEMICKÉHO KURIKULA

Radovan Sloup, Jitka Štrofová, Hana Sloupová

Abstract

The paper deals with critical points of the initial chemical curriculum. Critical points was identified during interviews with chemistry teachers involved in the OP VVV project “Didactics: Man and Nature A”. Involved teachers teach chemistry at secondary schools in different regions of the Czech Republic. The aim of the project was to propose innovations and changes in the concept of teaching topics, which are critical points in the teaching of chemistry at primary school. In mutual cooperation between professional didactics and teachers, modules, which used in teaching could reduce the criticality of these topics, have been designed. The paper introduces two modules related to chemical equations. These are “ notation of chemical reaction by chemical equation ” and “calculations from chemical equations”. After verifying these modules in practice at schools, feedback has been evaluated and specific modifications of the modules have been proposed, aimed at their further successful teaching use.

Keywords

curriculum; science education; chemistry

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INQUIRY-BASED SCIENCE EDUCATION - ELECTROLYSIS OF AQUEOUS SALT SOLUTIONS

BADATELSKY ORIENTO VANÁ ÚLOHA NA TÉMA ELEKTROLÝZA VODNÝCH ROZTOKŮ SOLÍ

Hana Sloupová, Milada Teplá, Martin Šrámek, Mgr. David Šarboch

Abstract

The aim of this paper is to introduce Inquiry-Based Science Education (IBSE) and evaluate its influence on pupils, specifically on their motivation as it plays a key role in teaching (not only) Science. A specific task focusing on the electrolysis of aqueous salt solutions is presented in this paper. This activity was realized at 9th grade of elementary school and at 3rd grade of eight-year grammar school in Chemistry as a laboratory session. There were 46 pupils included in this pilot study the goal of which was to find out the influence of incorporation of IBSE on pupils specifically on intrinsic goal motivation (interest / enjoyment, perceived competence; effort / importance and value / usefulness). The standardized questionnaire based on Intrinsic Motivation Inventory (IMI) tool was used to gain feedback after the laboratory session. The collected data were statistically processed and then interpreted. The results show that pupils evaluated this task as an average activity, in some cases the evaluation was slightly positive. Grammar-school pupils perceived the activity more positively regarding the importance of the task and realising their own abilities necessary for completing this task than the students at elementary school.

Keywords

inquiry based science education; chemistry; electrolysis; intrinsic goal motivation

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SCIENCE-ORIENTED EXPERIMENTS IN GERMAN LANGUAGE TEACHING
OR ACTIVATION OF LEARNERS VIA CLIL
PŘÍRODOVĚDNÉ EXPERIMENTY VE VÝUCE NĚMECKÉHO JAZYKA ANEB
AKTIVIZACE ŽÁKŮ PROSTŘEDNICTVÍM CLIL

Klára Sochorová, Martin Bílek

Abstract

CLIL, i.e. Content and Language Integrated Learning, connects the teaching of non-linguistic subjects with teaching of foreign languages. In our case, it is specifically the integration of Chemistry and German language. The contribution will be devoted to action research, which was focused on the implementation of science-oriented, mainly chemically oriented, experiments into German language teaching in the 9th class of the lower secondary school. During the school year, modules were incorporated into the teaching of the German language on those topics: water, properties of substances, elements, oxides, fire and organic chemistry. The research was focused on changes in popularity of foreign languages (especially German) and science subjects (Physics, Chemistry and Natural history) among learners after the inclusion of CLIL elements in the teaching. The action research took the form of a so-called cross-arrangement of the pedagogical experiment in two language groups, the experimental and control groups were exchanged in half of the research. The popularity of mentioned subjects was mainly investigated by repeated questionnaire surveys and supplemented by obtained from analysis of learners' portfolios.

Keywords

CLIL; action research; teaching chemistry in the german language

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THE INFLUENCE OF INTERACTIVE ANIMATION ON PUPILS' MOTIVATION AND LEVEL OF KNOWLEDGE AT SECONDARY SCHOOL

VLIV INTERAKTIVNÍ ANIMACE NA ZNALOSTI A MOTIVACI STŘEDOŠKOLSKÝCH ŽÁKŮ

David Šarboch, Martin Šrámek, Hana Sloupová, Milada Teplá

Abstract

This paper presents the results of the pilot study pursuing the influence of interdisciplinary and interactive animations on pupils' motivation and level of knowledge in chemistry education. The study was realized in 2018 at a secondary school. 30 pupils participating in the experiment were divided into a control group, that was taught in a traditional way, and an experimental group, where an educational animation was used in the education process. The hypothesis defined in this study is: „Pupils who are learning a specific amount of information using an interactive animation (the experimental group) reach better results as well as higher level of motivation than those who study with traditional educational aids (the control group).“ The hypothesis was affirmed by conclusions of several Czech as well as foreign studies. Two types of questionnaires were used as a research tool: MSLQ (Motivated Strategies for Learning Questionnaire) and IMI (Intrinsic Motivation Inventory). Furthermore, the pupils filled in a pre-test and post-test in order to acquire the difference in the level of knowledge between the control and experimental group. The collected data were statistically processed using specific statistical tests and then interpreted. According to the results, using interdisciplinary and interactive Adobe Flash animations in Science classes has a major influence on almost all aspects of motivation (interest / enjoyment, perceived competence and value / usefulness) and slightly smaller effect on their effort/importance. Moreover, the appropriate inclusion of the educational animations during the lessons has a positive influence on pupils' level of knowledge.

Keywords

Interdisciplinarity; interactive animation; pupils' motivation; pupils' level of knowledge

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PRESENTATION OF TWO INFORMATION LITERACY TESTS TARGETING UNIVERSITY AND SECONDARY SCHOOL STUDENTS

Andrej Šorgo, Tomaž Bartol, Bojana Boh Podgornik, Danica Dolničar

Abstract

Information literacy (IL) education should equip students to act as informed and responsible citizens and provide a base for their educational, professional and private activities as a part of life-long competences. Several studies have shown that IL needs to be taught and cultivated during the process of formal education in an engaging way. Most successful are those strategies based on inquiry and problem solving, which both involve IL. To achieve this goal, educators at various educational levels should have access to validated and reliable instruments to measure IL levels at different points in the course of education. Two distinct IL tests—both free of charge—have been developed by the authors, one for the university (ILT-HE) and the other (ILT-SE) for the secondary school population. The aim of the presentation is to provide participants of the conference with information about the structure and characteristics of these tests. The ILT-HE (Boh Podgornik et al., 2016) targets university students and was developed as part of the project "Development of information literacy of university students as a support for solving authentic science problems". The ILT-HE was tested on a population of 536 students. The ILT-SE (Dolničar et al., in press) targets secondary schools and was developed within the framework of the project "Development, testing and validation of an autonomous intelligent and adaptive e-learning system for the improvement of information literacy of adolescents". The ILT-SE was tested on a sample of 279 students at the beginning of their secondary education and 260 students at the end of it. Both tests show appropriate educometric characteristics and can be recommended for educational and research use.

The work was supported by the grant J5-8230 "Development, testing and validation of an autonomous intelligent and adaptive e-learning system for the improvement of information literacy of adolescents", provided by Slovenian Research Agency.

Keywords

Information literacy; university; secondary school; test

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ENTREPRENEURSHIP IN HIGHER EDUCATION

Andreja Špernjak, Tina Bastašič, Jurij Dolensek

Abstract

Entrepreneurship is one of the eight key competences, which can be developed even in higher education. The focus of entrepreneurship education is on teaching practice that aims to create and enhance students' abilities to act responsibly, to be active, creative, and able to seize opportunities, to assess and take controlled risks, and to plan and manage projects of suitable sizes. Slovenian students with national project 'Po kreativni poti do znanja' (translated roughly 'Creative career leading to knowledge') had an opportunity to develop all factors of entrepreneurship. In the article is represented how students manufactured a finger pulse plethysmograph measuring device named 'Fingerbeeper' and through cooperation developed entrepreneurship. The device has some advantages like simple usage that is adapted for (lower) secondary school; output of the device is straightforward to interpret by users as well as teachers, and because on the market we have some heart rate sensors perhaps most importantly advantages is very low production and maintenance costs.

Keywords

cooperation; entrepreneurship; higher education

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FOCUSED ON CHEMICAL EXPERIMENTS: AN ACTION RESEARCH DESCRIPTION

Martina Tóthová, Pavlína Matoušová, Martin Rusek

Abstract

Chemistry experiment is a teaching method that shows one of the greatest motivational potential in chemistry teaching. However, students' independent thinking is needed to effectively classify it. The present action research was aimed at identifying the use of experiments in the eighth and ninth grade Chemistry at lower-secondary school. Action research connects academics and preservice teachers with the real work of the teacher in the classroom. By linking two research methods (observation and analysis of students' experiment descriptions), the original state of using the experiments was evaluated. The lessons contained demonstration experiments, but most of the activity was teacher-centered. Students' understanding to the experiments was also not on a high level. After consulting literature, an intervention including the elements of IBSE was proposed. The results show that the design of the experiment processing assists the teacher in the involvement of elements of IBSE and the transfer of activity to students. However, the design of the experiment itself seems insufficient for their better understanding to the experiments. A possible cause may lie in the choice of an educational experiment, which should respect certain parameters, for example transparency. The principles for experiment selection and validation can be a theme for continuing research.

Keywords

chemistry; science education; experiments; inquiry based education

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COMPARISON OF RESEARCH RESULTS ON THE TOPIC OF MIXTURE

KOMPARACE VÝSLEDKŮ BĀDÁNÍ NA TĚMA SMĚSI

Kateřina Trĉková, Petr Bujok

Abstract

The article provides a comparison of the results of research tasks within the Research Days organized by the Department of Chemistry of the University of Ostrava in May and September. At the beginning of the 1st research day, a briefing was given on how to solve problem tasks, and at the beginning of the 2nd research day feedback was provided in the form of corrected worksheets according to the methodology prepared by us. The biggest difficulty was for pupils to divide the multi-component mixtures: Chemical Disaster and Cinderella's chemical torment. These tasks were verified by 80 pupils from two different multi-year grammar schools and a class of primary school of science. The results of the solution of 25 two-member groups of pupils who completed both research days were used for comparison. During testing, it was found that pupils had the greatest difficulty in recording observation results, using accurate device terminology, and formulating the research problem. Comparison of individual schools at the beginning of the survey revealed large average point differences between groups of students of grammar school A - 39, 56 points, grammar school B - 51 points and elementary school - 54.38 points, caused by different teaching style of individual teachers, pupils working habits and manual skills. A very interesting finding is the average point comparison of all three schools on the second day of research: grammar school A - 55.44 points, grammar school B - 54.13 points and primary school 55.25 points. Further evaluation results from self-assessment cards will be statistically processed.

Keywords

peer Assessment; peer learning; problem solving; project based learning; reflective inquiry.

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THE EFFECT OF PROJECT-BASED TEACHING ON UNDERSTANDING OF ENVIRONMENTAL IMPORTANCE OF EVAPOTRANSPIRATION

VLIV PROJEKTOVÉ VÝUKY NA POCHOPENÍ EKOLOGICKÉHO VÝZNAMU EVAPOTRANSPIRACE

Zbyněk Vácha, Jan Pokorný, Renata Ryplová

Abstract

Vegetation plays an absolutely fundamental role in the current climate change. With the evapotranspiration process (i.e. transpiration of plants + evaporation from soil), where most of the solar energy impinging upon the Earth surface covered with the vegetation well supplied with water is converted into latent heat concealed in the water steam, the surrounding environment cools down.

The latest researches show that pupils and students are almost unaware of the transpiration principle. The contribution brings results of a survey monitoring the impact of the project-based teaching on the level of pupils' awareness in the field of the environmental importance of water dispensing by plants.

Data, which finds out the level of pupils' cognitive knowledge, was obtained based on the experiment method with the use of the pre-test – post-test system. Entry knowledge of the pupils was tested prior to the experiment (pre-test) in the field of environmental importance of the transpiration. One week following attending in the themed project, the pupils were tested for output knowledge (post-test), wherein the final results from the test were used as a base for comparison of pupils' knowledge prior to and after the teaching. The results indicate the increase of pupils' knowledge about importance of the evapotranspiration in the landscape.

Keywords

project-based teaching; evapotranspiration; experiment

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PROBLEM-BASED TEACHING IN ENGINEERING AND TECHNOLOGY CLASS IN GRADE EIGHT IN PRIMARY SCHOOL

Andrej Velikonja, Kosta Dolenc, Mateja Ploj Virtič

Abstract

The paper presents Problem Based Teaching (PBT) as an active approach in the educational process in engineering and technology (EAT) class in grade eight in primary school. Based on the theoretical background, we planned didactic sets, designed and implemented problem tasks and observed the results. Taking thoughtful, engaging content and problem-based tasks, we are stimulating thinking processes and achieving higher learning goals. The study included 54 13-year-old students who were given different problem tasks, according to curriculum learning goals.

Basic descriptive statistics and qualitative methodology methods (activity monitoring, anecdotal records, photographic and video monitoring of activities) were used for the analysis. Results of the study gave us the guidelines for implementing PBT at EAT classes. Regarding to different aspects, we found that during the process of solving new problem situations students had to use higher and more complex cognitive processes, during the planning of learning sets, the emphasis was given to integration of the advanced findings at the problem approach; students could actively focused on the cognitive, constructive processes, they were co-producers and co-performers of the creative process oriented to individual search and critical use of information. There is an additional challenge in a lack of materials. They were creative at the implementation of tasks and at the autonomous search of the solution strategies.

Keywords

primary school; problem based teaching, engineering and technology

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BOARD GAME ABOUT MODEL ORGANISMS: PROCESS OF CREATION AND PILOT TESTING

DESKOVÁ HRA ZAMĚŘENÁ NA MODELOVÉ ORGANISMY: PROCES TVORBY A OVĚŘENÍ

Karel Vojíř, Linda Němečková, Dagmar Říhová

Abstract

Identification and knowledge of representatives of fauna and flora are integral part of primary science education. To this purpose, a board game was created. Didactic game is one of the fundamental methods, used in the process of fixing of acquiring knowledge. It serves to the social and personal skills as well as logical thinking development. The crucial problem in the science education is the selection of basic subject matter. It also applies in selection of typical members of organisms appropriate to be known by pupils. The goal of this contribution is to present the methodology of model organisms' selection with the regard of Czech nature variability expression. Created education board game was piloted in the 4th and 5th grade the elementary school classes and the modified Intrinsic Motivation Inventory (IMI) tool was used to gain feedback. Two subscales interest/enjoyment and value/usefulness were used. The results of the pilot inventory show that pupils assume this game as interesting and useful to learning process focused on organisms. The suggested methodology of organism selection was verified during board game creation. It is functional procedure for selecting a set of model organisms. The game proves motivation potential which makes it a good aid in acquiring basic facts about organisms.

Keywords

science education; primary school; model organisms selection

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USING OF STRUCTURAL ELEMENTS IN LOWER-SECONDARY CHEMISTRY TEXTBOOKS IN CZECH REPUBLIC

POUŽÍVÁNÍ STRUKTURNÍCH PRVKŮ V UČEBNÍCÍCH CHEMIE PRO ZÁKLADNÍ ŠKOLY V ČR

Karel Vojíř, Martin Rusek

Abstract

Textbooks are widely-distributed didactic tool whose task is to perform several functions in teaching. This is not only the text which refers to educational content, but also a means of structuring the curriculum, activating and motivating students, managing learning etc. These functions are provided through the various structural components in the textbooks. The influence of individual elements on the quality of teaching is influenced not only by the quality of these elements, but also by their use in teaching. This contribution is aimed at presenting results on the method and frequency of use of individual elements in chemistry textbooks for primary schools from the teachers' perspective. Teachers' considered importance of these elements for the quality of chemistry teaching was also examined. The data was obtained by means of a validated and piloted questionnaire in electronic form. It was completed by 387 chemistry teachers from 370 primary schools. Out of the 15 structural elements evaluated, teachers often use: the structured text, photographs and educational illustrations. These elements are used by the majority of teachers to implement teaching. In contrast, the plain text is most used by teachers to prepare teaching. They are least often used for out-of-school topics, explicit goal setting and references to other sources

Keywords

chemistry textbook; didactical equipment; structural components

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