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Let's Look Beyond the Borders of Our Specialty

Dear Readers,

You have just opened the first edition of the second volume of our shared ICTE Journal. We are glad to have gained the interest of both the readers and the authors. In this volume we want to share new information and findings regarding the dynamically evolving field of ICT in education. As far as the topics are concerned, this edition is well diverse. The reason for this diversity is explained toward the end of the editorial.

The first article "Use of E-portfolios in Education" was written by Viktor Fuglík (Department of Information Technology and Education, Faculty of Education, Charles University in Prague, CZ). For many organizations and teams the E-portfolio represents a very useful tool during the learning process and verification of effectiveness of the new technologies. The article offers a detailed comparison of different approaches and illustrates the usage possibility of the E-portfolio in the Czech Republic.

The second article "ICT on Four Levels of Inquiry-based Science Education in Environmental Education" is a collaboration of the authors Jana Přinosilová , Erika Mechlová and Svatava Kubicová (University of Ostrava, CZ). The article focuses on the description of the particular technologies that are available and in use in elementary schools in connection with the different levels of Inquiry-Based Science Education. The article also deals with the environmental education. It also contains a sample worksheet for the students of elementary schools.

The third article "Analysis of Children's Professional Orientation at Senior Primary Grade" is a collaboration of the authors Radim Badošek and Tereza Kimplová (Department of Pedagogical & School Psychology, Pedagogical Faculty, University of Ostrava). The article summarizes basic facts about the outputs of a research project which was focused on students' professional orientation as well as technical and practical competences of the second level students of elementary schools in the Moravian-Silesian Region (CZ). The results of the research, which show preferences of the interests structure, are very interesting and the entire article is certainly worth reading.

The appendix informs of the newly being built Science and Technology Center in Ostrava (CZ). Those interested can already try interactive exhibitions that are available in the open part of the center. In the world that was inspired by the novels of Jules Verne, visitors can learn about the technology and techniques which contributed to the development of the Ostrava industrial region. The ICT department of the Pedagogical Faculty of the University of Ostrava (CZ).cooperates with the center on preparing modern education with the use of ICT.

What is the reason of the thematic diversity of this issue then? Sure you will agree with us that interesting, original and inspiring ideas are often born on the borderline of different fields. There are cases when an analogy from a completely different field can be very inspiring when dealing with the problems of our field. Finally, none of us creative workers wants to recycle the same ideas over and over again and let our career become a routine. To achieve that goal it is necessary to have a deep insight not only into one's own specialty but also an overview of the entire field and related disciplines. These are the reasons for the thematic diversity of this volume of the ICTE Journal.

In future editions we would like to look further beyond the borders of our field again or offer the viewpoint of other disciplines on our field. We will welcome any cooperation in trying to fulfill these goals, should you be interested. If you are familiar with our field or know any particular authors whose view from the outside could be inspiring for other readers of the ICTE Journal, feel free to let us know.

Have an interesting and useful read.

Pavel Kapoun

Executive Editor

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USE OF E-PORTFOLIOS IN EDUCATION

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Abstract

E-portfolio is commonly used to support evaluation process in all forms of education. It is considered to be a very useful tool by many professional organisations, working groups, projects and it is the leading topic of many conferences and workshops. These initiatives drive the development of e-portfolio and enhance its using with new technologies in education. By their activities – studies and methodical support – initiatives directly influence governments and especially education practice. The very important result is improving frequency of using e-portfolio during learning process and verification of effectiveness of the new technologies. The article offers detailed comparison of e-portfolio initiatives and shows connections and its possible application in the area of the Czech Republic.

Keywords

education, educational system, evaluation, e-portfolio

Introduction

Evaluation is currently widely discussed topic. Eurydice (Eurydice, 2011), OECD (OECD, 2012) and other European and world organisations regularly inform about this field. One of the observed tendencies is a gradual departure from summative and normative assessment, i.e. from those forms, which separate assessment from other aspects of education, they do not see a student as a partner in the education process and they do not perceive their self-awareness and distinctiveness as a base for their mutual relationship. Innovative approaches, which belong to this field, are e.g. introducing individual norms for every student, dispersing their doubts and concerns about negative assessment, encouraging student's participation in education, emphasizing self-presentation and self-understanding and paving the way to metacognitive thinking, during which students reflect on themselves the process and meaning of their learning (Suskie, 2009).

A number of published international surveys support this trend worldwide and this trend manifests itself in national and supranational conceptual and curricular materials as well. The importance of assessment is also obvious in the revised Bloom's taxonomy of learning objectives for learning, teaching and assessment, in which evaluation is placed on the second highest place in the cognitive domain. Equally, metacognologists define evaluation as the fourth highest level of the cognitive domain, before which they place knowledge of facts, conceptual knowledge and procedural knowledge. Mainly these innovative approaches to education require new stimuli of tendencies in education. One of the ways to achieve these attempts is to use evaluation tools. Pupil's, or student's portfolio, belongs to one of them, and it is also the topic of this article.

From the local school education programmes for primary (ISCED 1 and 2) and secondary schools (ISCED 3) and their guidelines for assessing education and student learning, it has been obvious recently that Czech schools are aware of current international trends in assessment and evaluation and they try to implement them into their curricula, which is possible due to the reform of education approved by the government in 2004. They also reflect the issue of portfolio assessment even though it is not stated in the Framework Education Programme for Basic Education (VÚP, 2005). Czech universities and high schools approach this type of evaluation differently and work with portfolios is usually done within departments (Tomková, 2008), exceptionally faculties (Svatoš, 2008).

The use of e-portfolio in education

Due to a considerable fragmentation of information in the use of portfolios in education, the attempts and initiatives which try to uncover its advantages, but also difficulties in implementing and using portfolio in education, are very important. These facts are underlined by the fact that portfolio has been making its way into its electronic version as e-portfolio (Lorenzo, Ittelson, 2005). For the purpose of an easier overview and understanding opinions on e-portfolio better, interesting world organisations, surveys and projects were chosen, which deal with this area and they can serve as valuable sources for deeper contemplation of portfolio evaluation. The part showing the use of portfolios in our country forms an integral part of this article.

Organisations worldwide and their activities

Within their activities, or having it as their main activity, a number of significant national and supranational organisations deal with e-portfolios. This characteristics concern mainly the following institutions:

European Institute for E-Learning[1] (EIfEL) is a not-for-profit association whose mission is to support organisations, communities and individuals in building a knowledge economy and a learning society through innovative and reflective practice, continuing professional

[1] http://www.eife-l.org

development and the use of knowledge, information and learning technologies. EIfEL holds the International ePortfolio & Identity Conference (ePIC conference), it was also leading the Europortfolio consortium and was a founding member of The European Foundation for Quality in E-Learning (EFQUEL).

Europortfolio[2] is a consortium that promotes the use of e-portfolio in education. It contributes to the definition of technical standards, interoperability between portfolio and other portfolio-related technologies and services, establishes a reference platform implementing standards, updates current occupational standards of competence to promote the use of ePortfolios, provides support to and coordinates European initiatives with other national and international initiatives, mobilizes resources required to achieve its mission. It was set up by EIfEl and the following organisations.

European Foundation for Quality in eLearning[3] (EFQUEL) is a European foundation, the aim of which is to improve the quality of e-Learning within the EU by means of providing support within excellence and innovation. It is a network with over 100 members such as international corporations and universities and it has launched a range of worldwide projects. Its members meet regularly in order to share their experience. They have also an access to a range of sources and databases in the field of e-learning.

European Schoolnet[4] (EUN) is a network of 30 countries in Europe and beyond. It brings innovation in teaching and learning by means of supporting ICT, cooperation of schools and sharing their experience. Its stakeholders are ministries, schools, but also teachers and researchers. In the Czech Republic, we use EUN services to share good practice examples in ICT and to join the projects initiated by the European Commission. The Centre for International Services[5] is a coordinator of their activities. In 2010, the following European survey was published: *Review of National Curricula and Assessing Digital Competence for Students and Teachers: Findings from 7 Countries*. It deals with assessing digital competence of pupils, prospective teachers and teachers and ePortfolios are mentioned in connection with the ability of assessment and self-assessment (Balanskat, Gertsch, 2010).

Centre for Educational Technology and Interoperability Standards (CETIS) supported by non-governmental educational organisation JISC was mentioned in connection with the Leap2A standard. In the past, CETIS co-financed the projects by the British Newcastle University[6], working on its own ePET e-portfolio[7] and in connection with portfolios in 2005-2009 it realized two projects called EPICS[8]. Within these activities and in cooperation with other British universities, CETIS worked on case studies concerning ePortfolios in education. In 2008, JISC published the publication *Effective Practice with e-Portfolios*, which sums up its current JISC-funded projects in the form of a guide with effective instructions for the use of ePortfolios and

[2] http://www.europortfolio.org
[3] http://www.efquel.org
[4] http://www.eun.org
[5] http://www.dzs.cz
[6] http://www.eportfolios.ac.uk
[7] http://www.eportfolios.ac.uk/ePET
[8] http://www.eportfolios.ac.uk/EPICS

examples of good practice as a support to learning and teaching and as an aid to progression to the next stage of education or to employment (JISC, 2008).

IMS Global Learning Consortium[9] is an American association to support standards and specifications on the basis of e-learning. It represents more than 160 organisations worldwide coming from every sector of the global learning community. IMS provides a neutral forum in which members work together to advocate the use of technology to support and transform education and learning. One of its panels aims to standardize the digital information exchange in ePortfolios and to publish universal specifications applicable to all systems which are interested in storing portfolios or in exchange with other systems, be it ePortfolio systems, education platforms (e.g. VLE Moodle), portals, evaluation systems, students' systems, social networks or others.

Since 2001, in recent years in London, there has been held an annual international conference ePIC[10] (International ePortfolio & Identity Conference) under the auspices of EifEL and partners. It deals with questions about personal e-portfolio, its contribution to the process of building human identity and support for acquiring skills in the 21st century, support of lifelong learning, its orientation in employment and also insufficient interoperability of ePortfolio systems. ePortfolios Australia Conference[11] belongs to further significant conferences. It has been held since 2010 by Curtin University, Perth. Its topics are vocational education and training, higher education, and community education.

Studies and projects

Various educational institutions coming from a range of sectors in the field of education, vocational education and training, lifelong learning and beyond, e.g. human resources or employability, deal with e-portfolios. Also a number of publications and surveys deal with ePortfolios and their use in practice. Some of them are presented below.

The already mentioned JISC study from 2008, which is a part of the e-portfolio portal[12], contains structuring of the use of ePortfolio from the learner's viewpoint in the system of initial or continuing education and from the viewpoint of portfolio audience. The survey points out the importance of the choice of used technology and the necessity of mutual communication and proper training so that the philosophy of portfolio would be accepted by older students, who are not used to such type of work from the beginning of their education. It also points out the importance to support diversity among students and their creative participation. From a practical point of view, portfolio must provide an opportunity to study, learn, teach and evaluate procedures, train and support current needs and self-evaluate. The study points out the necessity to change the dynamics of learning and teaching and that it is the pedagogy not the technical tool that comes first. It also shows good results with blogging as a way to create learning communities and to use its extracts for PDP (Personal development planning) and CPD

[9] http://www.imsglobal.org
[10] http://www.epforum.eu
[11] https://eportfoliosaustralia.wordpress.com/conference-eac2011
[12] http://www.jiscinfonet.ac.uk/e-portfolios and http://www.jisc.ac.uk/eportfolio

(Continuing professional development). In terms of institutions, using e-portfolios requires careful management in order to beneficial. We need to reflect on identifying what is appropriate and sustainable, aligning curricular practice, managing potential risk factors and preparing for future development of systems. It is important to imagine all models of implementation and choose the most suitable ones, establish e-portfolio culture for its use and provide appropriate human resources including experienced project leaders and tutors working with students. Last but not least, it also concerns transferring data from portfolio into institutions.

Lifelong learning, extending far beyond formal education, encompasses a wide range of learning scenarios, including continuing professional development, job seeking and career change, and formal and informal learning. e-Portfolios are particularly important in lifelong learning, since a presentation, providing evidence of learners' progress over time and in the context of self-evaluation, enables reflecting on personal strengths and weaknesses and recognising gaps in existing knowledge and competences. A huge emphasis is put on continuing professional development, gained appraisals and peer feedback, or colleague feedback and the opportunity to evaluate each other. Since there are a variety of e-portfolio system types, it is important to select one that will meet its intended purpose, no matter if it is a commercial system or open source product, or a portfolio as such, or a package of mutually interconnected applications. Applications which can be easily integrated into already existing tools are most welcome here. From the point of effective use of portfolios, the portfolio audience is important, i.e. the people who are going to assess the portfolio. Among the audience, or target groups, the authors rank the following: classmates, workmates, teachers, tutors, but also personnel departments, employers, or appraisal and quality enhancement teams. According to the study, it is therefore important to engage into the work with e-portfolios those target groups, in which the impact of portfolios is under-researched. The selection of evidence for an e-portfolio presentation needs to be definite, pertinent, and tailored to the needs of the audience. For this purpose, it is necessary to ensure that the objects form data storage could be presented in the required presentation form or in a different form (JISC, 2008).

Other studies, which deal with the impact of e-portfolio on society, are the studies by BECTA[13] (British Educational Communications and Technology Agency), a British educational agency, the main task of which was ICT support and integration into education. In 1998- 2011, is was financed by the Ministry of Education, the UK. In 2009, BECTA published an e-Portfolio study for apprentices called *E-portfolios for Apprentices: A guide for providers and employers on functional requirements* summing up conditions, requirements and specifications for implementing an effective e-portfolio system into apprentices education (ISCED 3B a 3C). Its aim was to help the school practitioners make informed choices about e-portfolio suppliers, buy and use it effectively (BECTA, 2009).

MOSEP[14] is one of the big European projects supported by the European Commission within the Leonardo da Vinci programme. This project ran in 2006 – 2008 with participation of Austria, Bulgaria, Germany, France, the UK, Poland and Lithuania. MOSEP stands for *„More Self-*

[13] http://webarchive.nationalarchives.gov.uk/20110309145656/education.gov.uk/schools/adminandfinance/procurement/ict/a0073825/becta

[14] http://www.mosep.org

Esteem with my e-Portfolio". The project focused on the self-esteem of young learners completing lower secondary education and choosing between going into upper secondary education or entering vocational training for their future career. The aim of the project was to develop a set of measures for the use of e-portfolios in different contexts. The outcomes of the project were a study, an online course, and accompanying materials for e-portfolio use focusing on training teachers, trainers and on support of teacher training institutions[15]. Mahara translated into the national languages of the project countries was selected as an e-portfolio system for this project. A summary report presents also other systems used worldwide and their structuring (MOSEP, 2007).

Eportfolio and Europass[16] was an international European project funded by the European Commission multilateral fund. It ran in 2008 – 2009 with the participation of France, Poland, Germany, Belgium, Rumania, Italy, Portugal and Estonia. The aim of the project was to create an on-line system of learning content and pedagogies and to provide support to the recognition of non-formal and informal learning in order to improve the attractiveness of higher education and vocational training systems. Methodology and tools for issuing diploma supplements and their certification were also part of the project. Key ePortfolio activities concerned quality, accreditation and self-evaluation, language portfolio, cooperation of e-portfolio and Europass[17] serving as *„a European set of documents on education, personal competencies, language knowledge, qualifications and work experience"*, and introducing numerical literacy into Europass.

Australian ePortfolio Project[18] (AeP) is an Australian national project funded by the Carrick Institute for Learning and Teaching in Higher Education and The Australian Learning and Teaching Council. The project ran in two stages in 2007 – 2009 at local universities and with international collaboration. The aim of the first stage of the project was to investigate ePortfolio practice in the higher education sector in Australia in order to provide strategic and practical guidance about the use of ePortfolios in academic institutions. Next project aims were to consider the impact of ePortfolio use on student learning outcomes, to recommend ways to share excellent practice in the implementation and use of ePortfolios, to identify opportunities to advise and support their further development, and to develop community to support their future use in Australia. The second stage of the project was based on the outcomes of the first stage, which contributed to the competiveness of Australian graduates in a global employment market and to developing the relationships with international stakeholders across the school, vocational, business and professional sectors, as well as with worldwide ePortfolio communities. The second stage sought to extend the original aims into establishing, facilitating and encouraging an Australian Community of Practice for ePortfolio researchers and practitioners, and into introducing a regular Australian conference to provide a forum in which to explore and discuss ePortfolio research and practice. ePortfolios Australia Conference belonged to one of the project activities.

[15] http://www.mosep.org/index.php/lang-en/toolbox
[16] http://www.eportfolio-europass.eu
[17] http://www.europass.cz
[18] http://www.eportfoliopractice.qut.edu.au

Also a new educational policy of New Zealand sought inspiration in a modern ICT concept. It was represented by the local Ministry of Education[19] in the form of new New Zealand Curriculum in 2007 and of The National Digital Strategy from 2008. Within this concept in the field of ICT for primary and secondary education, an already existing national service Virtual Learning Network (VLN) was incorporated into the National Curriculum. It provides support for students, teachers, schools and clusters. Specifically it targets schools wishing to collaborate with other schools and educational organisations and it provides them with a web based platform, online tools and support of collaborative projects. The popular activities include exchange of experience, communities of sharing experience (Communities of Practice), web conferencing, video conference and audio bridge, video streaming and educasting, learning platform based on the social learning platform Elgg, a tool for collaborative learning techniques (LAMS), e-learning environment Moodle, an e-portfolio administration system (Mahara). VLN plays a key role in enhancing the capability of teachers, schools, and other educational organizations. It seeks to support staff to become confident users of ICT, to provide leadership and advice to teachers and principals developing quality online networked tools, and to offer teachers environments initiating and coordinating their collaborative partnerships with other stakeholders.

Portfolios in the Czech Republic

Even though we cannot compare, as for the extent and depth, national theoretical and practical e-portfolio activities with the above mentioned international activities, we can find interesting activities even in the Czech environment. The older ones focus on students' portfolios only, whereas current activities emphasize the use of e-portfolios.

The Research Institute of Education in Prague (VÚP), which became a part of The National Institute of Education in 2011, works on several activities, which deal with e-portfolios, e.g. a project supporting the European Language Portfolio[20] in practice, used as an official European certificate in foreign language skills in the EU. It comprises a language passport keeping records of the pupil including their language skills according to the international levels in particular areas, a language CV recording a gradual process of language learning and self-assessment, as well as a personal file of documents and works including certificates and materials documenting pupil's performance.

One of the aims of VÚP in the above mentioned project is to make a digital version of the European Language Portfolio as one of the modules on the Methodology portal Framework Education Programme (RVP) operated by VÚP. The experience with the Dutch system and the electronic version of the language passport Europass for adults should be used. According to the blueprint, four versions in several languages reflecting on the pupils' age should be made. VÚP is going to run seminars and workshops for teachers within further education for teachers and practitioners. Digifolio[21] is next activity by VÚP on the RVP portal, which was integrated

[19] http://www.minedu.govt.nz/
[20] http://www.msmt.cz/mezinarodni-vztahy/evropske-jazykove-portfolio
[21] http://digifolio.rvp.cz

into the Methodology II project funded by the European social fund in 2009. It is a full-bodied implementation of e-portfolio in Mahara, primarily used for administration of the teachers and institutions portfolios. Thanks to this, pages of schools, communities and other educational institutions can be established. It is also possible to present project and topic portfolios.

In 2005 – 2008, KVALITA I[22] system project funded by the European social fund ran in the Czech Republic. Its aim was *„to extend the system of pedagogical evaluation on different levels and hence support the quality of education and curricular reform"* in primary and secondary education (ISCED 2 a 3). The Centre for Gathering Educational Results (CERMAT), Institute for Information on Education (ÚIV) and The National Institution of Technical and Vocational Education (NÚOV) also took part in the project. It targeted a pupil, school and educational system as such. In terms of the pupils, the evaluation of crucial moments on the educational path of primary school pupils belonged to the main activities of the project. It was done through personal portfolio as a tool for continuous evaluation.

As for primary and secondary schools, the tools for evaluation and self-evaluation of learning outcomes belonged to the main activities. In terms of educational systems, the project activities comprised international pedagogical surveys (mainly PISA), national research and use of project outcomes for changing educational policy. All activities were under the umbrella of support systems helping to implement the system of pedagogical evaluation, which featured mainly seminars for the public and further education for school management and practitioners[23].

The research on personal portfolio consisted of portfolio evaluation at schools, computer adapted tests and a bank of tests. In terms of portfolio evaluation, the project focused on mapping the experience with portfolios at Czech schools and it encouraged schools to implement evaluation through portfolio into common ways of pedagogical evaluation[24]. In school year 2007/2008, a questionnaire was distributed to teachers of 14 primary schools and one secondary grammar school, all of whom worked with portfolios. The teachers were to answers the questions such as why they use portfolios, how they integrate them into the lesson, what kinds of portfolios and self- evaluation methods they use, pupils' and teachers' feedback. They also commented on their appropriate use and possible difficulties, which they encountered while working with them. They supported their activities with examples of portfolios from particular schools[25]. Follow-up proposals on further work with portfolio were prepared. They were divided into the following categories: for pupils, for teachers and for parents supplemented with hands-on advice on working with portfolio.

Examples of the use of e-portfolio can also be found in primary and secondary education, as well as in higher professional schools, e.g. Higher Professional School in Svaty Jan pod Skalou, were subjects such as Digital Portfolio I and II are taught. The teachers publish a number of articles on the use of pupil's, teacher's or institutional portfolio on the RVP methodology portal (Framework Education Programme) or other pedagogy-oriented portals. A lot of interesting information is also available in the school educational documents as evaluation rules for pupils.

[22] http://www.esf-kvalita1.cz
[23] http://www.uiv.cz/clanek/543/1001
[24] http://www.esf-kvalita1.cz/portfolio/oprojektu.php
[25] http://www.esf-kvalita1.cz/portfolio/portfolia/skoly.php

The Information and Communication Technologies in Education Conference belongs to significant conferences reflecting on Evaluation of ICT-supported education[26]. It is regularly held by The Pedagogical Faculty of University of Ostrava and this year, it is entering its 13th year. Among other topics, it deals with integrating ICT into education, e-learning, using software and hardware in learning and teaching, and educational projects.

Sharable Content Objects[27] (SCO) is an international conference with a long tradition, which has been held alternately by different faculties of Masaryk University in Brno since 2004. Within this conference, workshops and e-learning course showcase take place. Among other popular topics, the conference deals with e-learning in all its guises and its standards, methodology and pedagogy, pupils' and students' evaluation, Wikipedia, electronic information sources, digital libraries and information sources and schools in the knowledge society.

Conferences called MoodleMoot[28] are also worth noticing. They are held worldwide by partners and fans of Moodle virtual learning environment. Since 2010, they have been held in the Czech Republic[29] as well. Its organizers are Czech universities and education-oriented commercial sector. Trends in electronic learning, teaching objects and good practice solutions, remarkable Moodle implementations and cloud computing belong to the main topics of the conference.

As far as universities are concerned, The Faculty of Arts, Masaryk University[30] makes experiments with the installation of Mahara application. VŠB – Technical University of Ostrava launched a system based on wiki pages called Dig-I-Port[31]in order to illustrate networking and forming teams in research and development. E-portfolio penetrates into a number of university courses as well. Paper-based portfolio is more common in the Czech Republic. The Faculty of Education, Hradec Králové University, uses portfolio in teacher training and subject didactics (Svatoš, 2008). Similarly, at the Primary Education Department of The Faculty of Education, Charles University, students work with their portfolio and if they like, they can take advantage of it when sitting the final state exam. In order to support this approach, there is a subject called Building Student Portfolio. Courses focused on work with portfolio or on using their support run at other faculties of Charles University as well, namely eg. at The Faculty of Humanities and The Hussite Theological Faculty.

All educational institutions, Charles University included, are to use the UMIM.TO[32] web portal run by The Department of Information Technology and Education at The Faculty of Education. It is based on Mahara application 1.4 Version published in June 2011 and it is supplemented with its own Czech localization. It supports other national languages as well. The portal uses MNet technology and single sign-on system (SSO) for signing in. The latter is nowadays, apart from Moodle, used in other projects as well. The portal runs as a community project and everyone with their own installation of VLE Moodle 1.9 Version or higher can use it. After connecting a particular installation with the UMIM.TO portal, pupils or students' and teachers'

[26] https://konference.osu.cz/icte/
[27] http://sco.muni.cz
[28] http://moodle.org/course/view.php?id=33
[29] http://www.moodlemoot.cz
[30] http://elf.phil.muni.cz/mahara/
[31] http://rccv.vsb.cz/mahara/
[32] http://www.umim.to

user accounts are used in Moodle, which also verifies user's identification and their membership of a particular institution, or school. Users then sign in in Moodle and through a given link, they are forwarded to Mahara. School administrator of Moodle becomes at the same time an administrator of their institution on UMIM.TO, they have an access to specific portal settings, deal with users' requirements and coordinate a communication with administrators. A school can then take advantage of all functionalities of Mahara application and at the same time it can administrate their users and modify further settings by means of their administrator (Fuglík, 2011).

Discussion

The Education, Audiovisual and Culture Executive Agency (EACEA), which operates under the European Commission, perceives the need to integrate e-portfolio into learning process as highly up-to-date. This agency published within Eurydice, its international network, the document *Key Data on Learning and Innovation through ICT at School in Europe 2011*. It deals with evaluating key competences with the use of information technologies and in the *Educational processes* and *Assessment* section, it addresses current insufficient implementation of e-portfolios for pupil assessment and it considers portfolios *„a genuinely ICT-based assessment mechanism"* (Eurydice, 2011). The survey mentions, apart from e-portfolios, two more innovative approaches to pupil assessment, which can benefit from ICT. The first approach concerns using ICT for pupil self-assessment, the second is based on learning outcomes in connection with a paradigm of competences as target structures. Into key competences, we can rank secondary literacy as well, eg. information literacy. The study recommends that the evaluation of these literacies should be carried out only by means of ICT means. The Eurydice survey completed in school year 2009/1010 shows, based on the data provided by Czech primary and secondary schools (ISCED 1, 2, a 3), that self-assessment is seen as implemented, e-portfolios as planned and approaches to learning outcomes as so far unprocessed.

The survey also mentions missing recommendations of the Ministry of Education on the use of ICT for pupil assessment at central level. On the contrary, in the field of the evaluation of ICT competences through theoretical and practical exams and project evaluation, the Czech Republic uses all above mentioned tools compared to other countries. Unfortunately, this type of testing is not used for school leaving exams and when completing a particular educational stage. A computer literacy certification through unified ECDL tests is available in the Czech Republic, but the decision to certify their pupils and teachers against ECDL standards lies in schools. The ECDL concept is therefore used partially only (Eurydice, 2011).

Conclusion

From the above mentioned chapters it follows that evaluation with the accent on e-portfolio is currently an up-to-date topic worldwide at all education levels. The Czech Republic is no exception. We can see first signs of using portfolios as tools for evaluation, self-evaluation and self-reflection at all educational levels and also as occupational portfolios. However, Czech

evaluation of education still faces problems, which hinders the use of portfolios and which are newly summed up eg. in the OECD Reviews of Evaluation and Assessment in Education: Czech Republic 2012. The review recommends building capacities for evaluation in the whole educational system, supporting a teacher's role in pupil assessment and enhancing its systematization in connection with the introduction of national standardised testing, developing teaching standards, teacher appraisal and certification, strengthening school evaluation and evaluation in the whole evaluation and assessment framework (OECD, 2012).

Based on the examples of good practice and international experience, there was a pilot project on implementing e-portfolio into extramural studies in Information Technology running in the winter semester in school year 20011/2012. Its outcomes strengthened the motivation for its extension into other study programmes (Fuglík, 2012). Further implementation of portfolio evaluation for prospective teachers is about to happen also thanks to the teacher career structure, which is in preparation, and a related system of teacher certification. This is the area where not only practice or previous education, but also teacher portfolio should play its role. Currently, a transfer to the newest 1.5 Version of Mahara application is being prepared, which would bring a range of new functionalities and improvements towards the services based on cloud computing.

References

BALANSKAT, Anja and A. Christian GERTSCH. *Review of National Curricula and Assessing Digital Competence for Students and Teachers: Findings from 7 Countries*. Brussels: European Schoolnet, 2010, 116 s.

BECTA. *E-portfolios for Apprentices: A guide for providers and employers on functional requirements* [online]. 2009 [cit. 2012-04-08]. Dostupné z: http://www.jiscinfonet.ac.uk/e-portfolios/becta-ep.pdf

EURYDICE. *Key Data on Learning and Innovation through ICT at School in Europe 2011* [online]. 2011 [cit. 2012-04-02]. Dostupné z: http://eacea.ec.europa.eu/education/eurydice/documents/key_data_series/129EN.pdf

FUGLÍK, Viktor. UMÍM.TO : portál pro tvorbu, správu a sdílení e-portfolií. In ULRYCH, Miroslav. *Alternativní metody výuky 2011*. Praha: Univerzita Karlova v Praze, Přírodovědná fakulta, 2011. ISBN 978-80-7435-104-4.

FUGLÍK, Viktor and Miroslava ČERNOCHOVÁ. Research Findings on Implementing Student Portfolios into Teacher Education. *Efficiency and Responsibility in Education 2012*. Praha: Česká zemědělská univerzita v Praze, Provozně ekonomická fakulta, 2012. Dosud nevydáno.

JISC. *Effective Practice with e-Portfolios: Supporting 21st century learning* [online]. 2008 [cit. 2012-04-15]. Dostupné z: http://www.jisc.ac.uk/media/documents/publications/effectivepracticeeportfolios.pdf

LORENZO, George and John ITTELSON. An overview of e-portfolios. *EDUCASE Learning Initiative* [online]. 2005, roč. 2005, č. 1 [cit. 2012-03-18]. Dostupné z: http://net.educause.edu/ir/library/pdf/ELI3001.pdf

MOSEP. *Grab your future with an e-portfolio!* [online]. 2007 [cit. 2012-04-22]. Dostupné z: http://www.mosep.org/images/stories/attachments/mosep_study.pdf

SANTIAGO, Paulo. *OECD Reviews of Evaluation and Assessment in Education: Czech Republic*. Paris: OECD Publishing, 2012, 160 s. ISBN OECD Publishing. ISBN 978-92-64-11675-7.

SUSKIE, Linda A. *Assessing Student Learning: A Common Sense Guide*. 2nd ed. US: Jossey-Bass, 2009, 342 s. Jossey-Bass higher and adult education series. ISBN 978-0-470-28964-8.

SVATOŠ, Tomáš and Irena LOUDOVÁ. Obraz začínajících studentů učitelství ve studentském portfoliu. In *Pedagogický výzkum jako podpora proměny současné školy. Sborník anotací z 16. konference ČAPV.* Hradec králové: Gaudeamus UHK, 2008. str. 61-70. ISBN 978-80-7041-970-0.

TOMKOVÁ, A. Studentské portfolio ve studiu učitelství pro 1. stupeň ZŠ, nejen v pedagogických praxích. In *Integrovaný model reflektivní praxe*. Praha: PedF UK, 2008.

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ICT ON FOUR LEVELS OF INQUIRY-BASED SCIENCE EDUCATION IN ENVIRONMENTAL EDUCATION

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Abstract

Inquiry in the natural sciences is an often used term. Inquiry-Based Science Education with the support of sophisticated ICT lacking. Inquiry-Based Science Education has clearly defined its four levels, in particular the use of teaching depends on the particular pupils and teachers. This learning strategy can thus rendering the various options and the use of ICT available at the school. The following article's focus is on a selection of specific technologies available and used at a primary school in connection with the different levels of Inquiry-Based Science Education and the extent of its involvement. The paper also describes social elaborated topic of environmental education in the sample worksheet for elementary school pupils.

Keywords

ICT, Inquiry-Based Science Education, four levels of Inquiry-Based Science Education, activities with ICT, environmental education, computer supported experiment

A view on tendencies in contemporary education

Contemporary teaching documents for elementary schools are based on educational processes, fundaments of which lie in planning, organizing, conducting the learning process in such a way that knowledge, skills and attitude obtention comes through active participation. It is important to create optimal conditions for developing pupil's creativity.

Educational tendencies are based on an idea that a pupil should not acquire information passively but the acquisition should be based on his/her experience, knowledge and skills. An

important part of this concept is a special consideration of pupil's needs – acceptation of his/her world, findings, ideas, feelings, interests, personal pace and evolutional rhythm (Stuchlíková, 2010).

Pupil's competences develop during classes based on examples and situations from everyday life. This way learning gains personal sense. Examples and model life situations gives pupils the opportunity to perceive learning as an existentially important activity necessary for his/her personal life as well for surrounding world. Along with the learning process the pupil is lead towards self-control, self-examination and responsibility for his/her own decisions. They learn to work individually and cooperate in team.

Inquiry-Based Science Education applied on cross-sectional environmental education enables wide range of opportunities to connect ICT with this teaching strategy. This article points out possibilities of connecting ICT, four levels of Inquiry-Based Science Education and the environmental education. Pupils involved in pedagogical processes in grammar schools use information and communication technologies when learning natural sciences in different ways, depending on many factors. The level of exploitation depends on actual topics, hourly donation, teacher's and pupil's attitude towards technologies, and on an interest in refreshing the classes with something new and fresh.

Defining ICT literacy

ICT literacy is a collection of skills an individual needs necessary to decide when or where to use available ICT and effectively use them in order to solve different situations during the study or in everyday life in changing world. According to a collective work at VÚP in Prague - Literacy in education handbook ICT includes the following factors (Altmanová, 2010): At first practical skills and knowledge that enable an individual to use particular ICT effectively and with intelligence; the ability to complete, analyze, critically evaluate and use information with support of ICT; last but not least the ability to use ICT in different contexts and for different aims based on understanding the terms, concepts, systems and operations in field of ICT; knowledge, skills, abilities, attitudes and values leading to responsible and safe use of ICT; and also abilities to receive new stimuli in ICT field at the same time giving critical judgment, understanding fast development of technologies and its importance in personal evolution and the influence on society.

ICT Literacy in Education manual also states– a quite obvious fact – that today's condition of FEP ED enables the evolution of ICT literacy however does not support it consequentially. As the ICT usage develops in individual fields of human activities, it can be implicitly traced in key competences, characteristics and final aims of educational sphere and many other expected outputs of all educational fields as well as in cross-sectional topics in FEP ED. The field of ICT is in fact so complicated that in reality we cannot count on teachers to sensitize this to a necessary extend and make them put enough emphasis to reach methodological, systematic and steady evolution of all components of student's ICT literacy. ICT are stated exclusively in key competences (Altmanová, 2010). *Learning competences* – the pupil searches and sorts out information and based on understanding, connection and systematization uses them effectively

in learning process, creative activities and practical life. *Communicative competences* – the pupil understands different types of texts and records, picture materials, commonly used gestures, sounds and other information and communicative means. He/she analyses them, reacts to them and uses them creatively for the purpose of self-evolution. For the purpose of implementation into social life, uses information and communication means and technologies for high quality and effective communication with the surrounding world. The ICT are also mentioned in characteristics of such educational fields as *Language and language communication, Mathematics and its application, Information and communicative technologies, A Human and nature, Human and health, Human and the world of work.* Furthermore in expected output they can be found most often in study materials, but only in some educational fields or cross-sectional topics as *Personal and social education, Educating a democratic citizen, Education towards thinking in European and global context, Multicultural, Environmental and Media education*. There is wide range of individual tools and topics offered, sometimes focusing unilaterally.

Inquiry-Based Science Education in biological education

In the scope of biological education on grammar schools apart from classical teaching methods new ones should be applied; such as: activating and complex teaching methods preferring construction, discussion and cooperation from transmission and competition of individuals (Rosecká, 2006).

According to Bílek to obtain effective biological education, preference of educational methods based basically on self-examination, measures, experiment and evaluation of real actions, objects and states, on visualization and modeling, on active search and processing the data by the pupil is essential. Many different ICT technologies can be asserted here. Biological education enables pupils very well to apply a whole scale of various methods, respecting distinct characteristics of individual pupils. An outstanding element in teaching individualization are so called constructivist methods of „conducting" learning activities, which have been so far perceived as alternative teaching methods. A teacher becomes a „manager", mentor and helper. Pupils become active subjects of teaching by searching, obtaining, categorizing, rating, judging and processing information. Pupils discuss their findings with classmates and the teacher, refine their opinions, rectify their attitudes, or they can try to create their own „theories". Intellectual operations on various levels are induced with appropriate support and suited to individual characteristics. Their original concepts or individual experiences are confronted with facts brought via above mentioned sources of findings (Bílek, 2008).

A possible didactic means of educational innovation in biological subjects connected with environmental education is an Inquiry-Based Education (IBE) or Inquiry-Based Science Education (IBSE).

The meaning of the term „inquiry" apart from its basic meaning, includes also search for the truth and can be also qualified as target oriented process leading the pupil to gain the capacity to define the problem, comment it critically, find alternative solutions to the problem, to plan

the research, to conclude and deduct and to create model of investigated process. Application of IBE in biological education should be conducted in such a way that would awake in pupil the need to „to puzzle things out. Pupils are supposed to find out that research is the essence of biological sciences (Stuchlíková, 2008).

Concerning the external conduct of pupil's „research" differentiate four levels. Based on teacher's consideration, pupils can so work in Inquiry-Based Science Education of following four levels (Eastwell, 2009).

Confirmation research – students are provided with the question and action (method), results are known in advance, the purpose is to confirm a principle through own experience.

Structured research – the teacher presents question and possible action (method), based on their knowledge students determine the explanation of studied phenomenon.

Guided research – the teacher presents a research question but leaves the method and solution open to students.

Open research – students present a question, think of method, realize the research and define the results.

Four levels of Inquiry-Based Education give the teacher the opportunity to choose the most a form, which is the most suitable for particular moment for given group of pupils and topic. Learning in form of individual discovery represents a uniquely important method of knowledge acquisition. But to be successful in school conditions it is necessary to equip pupils with preliminary information and skills so that the intended goal is clear and adjusted to their capacity (Maňák, 2008).

Environmental education with use of Inquiry-Based Science Education with ICT support in worksheet draft

Environmental education as a cross-cutting theme produces educational space enabling employing practical research procedures. The goal is to enable pupils to understand given problem through their own research. To obtain the intended goal, worksheets as a didactical means for IBE were created. It is teacher's responsibility to follow the study materials and conduct the classes in a comprehensible manner.

Electronic worksheets for pupils contain experiments that are thematic outcome of environmental education cross-cutting theme and are a possible use of Inquiry-Based Education with ICT support.

Pupils verify their knowledge here or try to understand given issues which enables them a more knowledgeable perception. The experiments are long distance and it is up to the teachers or pupils how they deal with the schedule. Questions for reflection are part of the experiment followed by students' slideshow demonstrating their results and conclusions. When creating these materials pupils have to make use of gained knowledge. By presenting it as something they found out themselves they repeat and internalize it at the same time.

There is a pile of worksheets for pupils prepared in electronic version. Pupils can keep them or print just the necessary parts for the purpose of making notes if necessary. Pupils follow the worksheet and perform particular assessments focusing on understanding given issue. They try to discover the principles of the phenomena that they actually encounter every day. Worksheets are focusing on Inquiry-Based Education supported by simple experiments which pupils will execute individually or in groups. Special attention is given to the individual pace of pupil and to giving them a chance to ask questions whenever anything incomprehensible occurs. Also discussion among participants of educational process is important to enhance Inquiry-Based Education.

The reason of choosing water and air is that these are the substances which pupils commonly encounter but often they are not aware of the substances' importance on Planet Earth. Themes for particular worksheets Water and Air – basic life conditions:

- water and water pollution;
- drinking water;
- water circulation and its distribution in hydrosphere;
- particular characteristics of water;
- global warming and greenhouse effect.

Example of worksheet structure

1. Work with text

Pupils are given a short text (abstracts) derived from different sources, which they have to carefully read and understand. There are three simple questions or sentences following. Pupils have to give response to them. They don’t need any other particular source, the text contains all necessary information. It serves to introduce the issue or to evoke discussion among participants of educational process. Pupils should ask the teacher about issues that are not clear.

2. Work with information (internet)

Pupils answer and think about the questions, they use the internet and electronic sources (educational program on CD etc.) for support. Questions are related to the given topic and it is up to the pupils to answer as precisely as possible, or to support their answers. This motivates them towards critical thinking where they have to comprehend the text, its context and differentiate between significant and inessential information. The level of pupils' exactness gives the teacher the insight into the pupil’s comprehension of the essence of the outlined article.

3. Experiment

Experiment is the most important as well as the most laborious part of the worksheet, where pupils by means of their own simple experiment confirm their knowledge, or understand given issue and get a more comprehensive stand. Many experiments are long distanced and it depends

on teacher and students how they will deal with the time schedule. International biological research PISA inspired me during the preparation of the experiments, as well as tasks given during the biological Olympiad and environmental association Pasco and examples from Integrated biology in experiments publication. „Food for thought" questions are a part of the experiment followed by students' slideshow demonstrating their results and conclusions. When creating these materials pupils have to make use of gained knowledge and by presenting it as something they found out themselves, they repeat and internalize it at the same time. According to teacher's consideration pupils can work on the following four levels: Confirmatory research – questions and method is provided, results are given, own practice is to confirm the above mentioned. Pupils know the results of the experiment, because the teacher will provide it in advance. Structured research – teacher provides the question and potential method, pupils form the explanation of examined phenomenon based on already acquired knowledge. Directed research – teacher gives a question, students create method and then conduct the experiment. Open ended research – students ask questions based on the curriculum, think of the procedure, execute their own research and form results.

Some experiments are designed as computer supported, so that pupils have the possibility to use sensors and software designed for this kind of experiments. Measuring system eduLab is applicable, but also other systems are available at school.

The results of the experiment should be demonstrated via power-point presentation created on the computer. It is also possible to share the results at the on-line blog, or social network. Especially successful experiments, described or published can be inserted by the teacher as DUMs – digital educational materials and published on portals dealing with education.

4. Pupils' activities (questions for reflection)

Last part of the worksheet is to intensify the gained information and it depends on pupils whether they use help from different validated sources or answer these questions based on acquired knowledge in their own words. In some cases pupils are asked to prepare the power-point presentation for other pupils or to attach photos from particular experiments and exercises to the worksheet. All tasks and questions are part of so called additional curriculum, where pupils should show their ability to contemplate over the issue and sensitize connections between subjects. All school information and communication technologies are available. It is up to pupils which they want to choose (Přinosilová, 2012).

Following methods and forms of work with ICT are used in solving problematic jobs (Kubicová, 2011):

- computer aided experiment - remote experiment, virtual experiment;
- work with sensors and suitable software to execute the experiment;
- pupils preparing a presentations of the experiment results;
- sharing experiment results with other pupils on social networks and various blogs;
- students and teachers prepare presentations on certain topic;

- pupils and teachers prepare materials for interactive board;
- searching for information and working with information;
- publishing various materials on portals concerning teaching.

Example of worksheet for Inquiry-Based teaching in environmental education with ICT support on Greenhouse effect theme

Greenhouse effect

Presentation of a part of a worksheet, that was prepared for Environmental education, with ICT support (Mechlová, 2012).

Work with the text

„Long term measurements proved that within 140 years, the average temperature of the Earth surface increased by 0.8°C. Results of the research executed on drills in iceberg proved that the period between 1950 and now was the warmest period since 6000 years. The higher frequency of extreme climatic events has also been registered. It is expected that the level of the sea will rise which can lead – apart from unimaginable impact - to numerous social problems“. (Matějíček, 2007)

Questions related to the text:

1. How much has the temperature of the Earth surface increased, during last 140 years?
2. What research led to the conclusion that we live in the warmest period since 6000 years?
3. What is the most probable cause of the numerous social problems?
4. What does the term climatic event mean? (use all available sources to look for the answer and make a draft of examples of some climatic events)

Information search – internet, educational programmes

Enormous problem that causes global warming are greenhouse gases. A higher concentration of these gases in the atmosphere leads to intensifying of the greenhouse effect. (Matějček, 2007)

Work with the obtained information

1. Assignment.
2. Describe how the greenhouse works.
3. What materials are used to build the greenhouse and what are their features?
4. What would happen, if you placed a whole planet Earth in a greenhouse?
5. Search for gases that we call greenhouse gases. Draw its molecules!

6. In your own words describe the picture – polluted air, which your classmate found over the internet. What does it depict?
7. Using chemical formulas match the descriptions of the gases with the arrows on the picture. What do these molecules have in common?

Computer supported experiment

Execute a simple experiment!

Tools: 2 jars, caps, plastic bottle, sticky label, scissors, string, thermometer (thermo sensor), PC and the software for sodium hydrogen carbonate (soda), vinegar, balloon, straw.

Work flow:

1. Prepare a glass filled with „air“ (no. 1) and close the lid. Make a hole in the lid and seal it with the sticky label.
2. In the second jar, make a hole for putting a straw in it.
3. Put soda into the plastic bottle and pour as much as necessary vinegar inside. Quickly put a balloon on the bottle and wait until it fills with the gas. Bind the balloon with the string.
4. Slowly insert a straw into the balloon and then insert the straw into the jar. After the gas moves from the balloon to the jar, seal the hole with the sticky label.
5. Leave both jars in the sun for a whole day. Check the temperature of the gas inside the both jars and put them down into the results.
6. Write the chemical formula for emergence of the gas in the balloon.
7. Write what gases does the „air“ consists of in the jar no. 1.

Student´s activities – questions + exercises to think over

Questions:

1. What life on Earth would be like if greenhouse effect did not exist?
2. How do people influence the warming of the planet Earth?
3. Give suggestions to slow down the warming of the planet Earth. Can you influence it?
4. Who is the climate-sceptic? What are his opinions about the warming?

Elaborating exercises + individual presentation of the results – processing the results of the computer aided experiment, publishing the results, etc.

Question for headpieces:

1. What is the difference between the way the greenhouse works and the greenhouse effect?

Work sheets for Inquiry Based Education with ICT support on the theme of the greenhouse effect and results from practice.

Before the actual testing with the work sheets, 59 students were given a pre-test which contained questions on the theme of the greenhouse effect and other questions concerning the basic conditions for life. It was discovered that this group of students have the biggest problems with knowledge and inquiry based questions, where the largest number of blank answers or completely wrong answers were recorded. As far as inquiry based tasks are concerned, only two pupils answered at least one question with the maximum number of points. In other cases the answers were basically correct but often with mistakes or not thought through. Knowledge questions were, as far as exact replies go, a bit better, but even so the number of these correct answers was not at all significant. On hypothetical questions, the students always managed to answer in some way, even though many of their replies were literally the first thoughts which came to their minds.

In the case of other pre-tests used for verifying, where the difficulty of the individual questions was primarily evaluated, interesting results were discovered. From the viewpoint of the greenhouse effect, students have the biggest problems with questions 2, 17, 19, 20, 22, and 23, which are prevailingly from the inquiry-based group. These questions also have a high Q difficulty valuation. On the other hand question 3 appears as very easy while having a low Q difficulty valuation.

Test for students

(questions on the topic: the greenhouse effect)

Pre-test/Post-test – environmental education Name:

Answer these questions!

2. What is the name of the natural phenomena which contributes to maintaining a suitable temperature for life on the planet Earth and prevents the escape of warmth to outer space? (3b)
3. Try to think up a simple experiment by which you could prove this phenomenon! (3b)
4. What would happen to a hamster which was placed in a greenhouse in the summer? (3b)
5. Which atoms is a molecule of carbon-dioxide composed of? (3b)
6. What is the simplest way to get carbon dioxide as a gas? (3b)
7. How would planet earth look if the amount of carbon-dioxide was 70% (now it is 0.034%)? (3b)
8. What gases are called greenhouse gases? (3b)
9. Bred cattle produce a large amount of greenhouse gases. Suggest a way to limit this production, or at least moderate it! (3b)

10. CO_2 is a greenhouse gas and N_2 isn't. Try to write a rule which determines which gases are greenhouse gases. (3b)
11. Explain the process of global warming (3b)
12. Suggest an experiment which would prove that global warming is really occurring (3b)
13. In the past Greenland was settled, what will happen if the planet continues to warm? (3b)

A primary school in Ostrava participated in the testing using the work sheets on the topic of the greenhouse effect and the basic conditions for life. The participants were 9th grade students, who were attending a natural history course. The subsidized course amounted to 2 hours per week. The instruction took place in blocks. The number of students in the class was 15.

The students predominantly worked alone and with the assistance of the teachers on the work sheet tasks. According to need, the students were either in the natural history classroom, the computer classroom or in the multimedia classroom (with the interactive board). The students had all the technology which is used at the school available, including modern technology suggested by the students themselves and approved by the teachers, as well as sensors for computer supported experiments. The students used various forms of technology during the whole course of working with the work sheets. Discussion on the experiments carried out was guided by the teachers which tried to encourage the students' further interest in this field. Some tasks were carried out by the students as homework. The students gradually went through all tasks and completed them. Emphasis was placed on an individual work tempo. The students were also given a pre-test and a post-test containing questions which were divided into three groups: Knowledge based questions, inquiry based questions and hypothetical questions. The number of questions related to the „greenhouse effect" was 12. Other questions (knowledge based: question numbers 1, 16, 19, 22), (inquiry based questions 2, 17, 20, 23), (hypothetical: question numbers 3, 18, 21, 24). Awarding of points for questions: 0 – no answer or wrong answer, 1 – some indication of or an answer at least a bit connected, 2 – answer which is basically right but is either mistaken or incomplete, 3 – correct answer, extensive, innovative, without mistake. Overall the students could reach a maximum of 36 points (see Fig. 1).

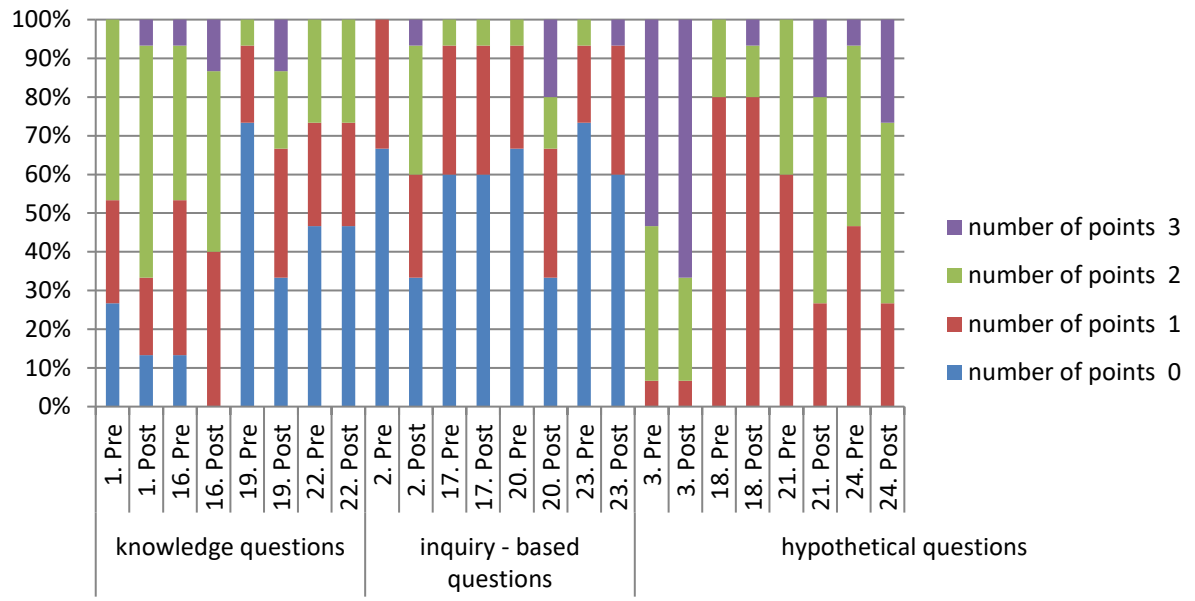

Fig 1: A comparison of the pre and post-test results of students who graduated the IBE education with ICT support on the topic of the greenhouse effect.

A comparison of the results of the pre and post-tests achieved positive results. The students managed to gain a better point score after completing the Inquiry-Based education with the support of all available technology at the school. The exceptions were questions 22 (knowledge based question) and 17 (inquiry-based question), which are questions with a high Q difficulty valuation. Other questions from this group of difficult questions 2 (inquiry-based), 19 (knowledge based), 20 (inquiry-based), 23 (inquiry-based) recorded a growth in the maximum gaining of points and a decline in the number of points with a zero score. It was again confirmed, even in such a small sample, that students do not have such a big problem with hypothetical questions, and without great difficulty they are able to write at least the minimum for gaining at least one point from the maximum point value, which amounted to three points.

Possibilities of connecting ICT with Inquiry-Based teaching from point of view of computer supported experiment

Within four levels of Inquiry-Based Science Education can be ICT implemented into computer aided experiment as follows (Mechlová, 2012):

Confirmation research

a) *Internet*. Searching for information and checking own answers, if necessary supplying other information concerning given topic. The teacher provides the student with web pages to help them find the information. The student will find the information in e-text.

b) *Teaching programs*. Practicing already discussed topic.

c) *Work with sensors*. Students follow the instructions. The result is known in advance. The purpose is to get acquainted with technologies which can be used during the

experiment and to confirm the correctness of the action (method) with respect to the outputs known in advance.

Structured research

a) *Work with sensors* following the task. Based on the measurements the student must evaluate on the results of the experiment. The student must analyze the result and deliver the conclusion in particular form answering the following questions: Why he/she executed the experiment? What did he/she found out?

b) *Preparation of presentation of their own results and justifying them.* Searching the internet for the information to confirm the obtained data.

Guided research

a) *Searching the Internet*. Searching for the information necessary to execute the experiment, following various simulations and animations connected with the experiment, an effort to optimize the experiment to the school lab conditions or outside it as an remote or virtual experiment.

b) *Presenting the experiment* to students in the class, justifying the method.

c) *Work with sensors. S*tudents execute the experiment, based on task given by a teacher. They choose their own suitable sensors. At first they analyze the strategy of executing of the experiment. They execute the experiment. Finally they will provide the following information: the aim of the experiment, reason the method of execution.

d) *Exploitation of all available technologies at school and beyond.* Individual students give proposals for solving the problematic jobs, in certain way also innovative methods. Publishing the job results and discussing them (social networks, school www network), preparing materials for interactive boards - supplementing the results of the experiment.

Open research

a) *Student's own proposals for experiments concerning the topic* presented by the teacher during the class-work. Students suggest their own experiments. They try to make use of sensors available at school. At the same time they try to suggest which sensors are necessary. They try to find out with the aid of the teacher and the internet whether the suggested sensors are available.

b) *Exploitation of all available technologies at school and beyond.* Individual students give proposals for solving the problematic jobs, in certain way also innovative methods. Students publish the results. The results of the experiment are discussed among other students (social networks, school www network). Students prepare materials for interactive boards - supplementing the results of experiment.

Possibilities of connecting ICT with Inquiry-Based oriented teaching from point of view of computer supported experiment

Inquiry-Based level / ICT activities	1. Confirming	2. Structured	3. Guided	4. Open
Work with the internet	5	5	5	5
Work with educational programmes	5	5	3	3
Work with sensors executing an experiment (real, virtual, remote)	5	5	5	5
Preparation of presentation on given topic	3	4	5	5
Presentation of executed experiment using available software tools and applications	2	3	5	5
Publishing of the experiment results and discussion (social networks, school network, www network)	1	2	4	5
Preparation of materials for inter-active board	1	2	4	5

Tab. 2: Possibilities of connecting ICT with Inquiry-Based oriented teaching from point of view of computer supported experiment (0 – never, 5 – very often)

Computer supported experiment in four varieties depending on the level of Inquiry-Based Science Education

As an example of teaching with ICT support can serve aforementioned experiment with carbon dioxide called „Carbon dioxide is a greenhouse gas“. The aim of the experiment is to make pupils realize the basics of greenhouse effect based on common gas carbon dioxide, which they encounter every day. Depending on their skills pupils work on different levels of IBE so that at the end of their work they acquire the knowledge in their own ways.

Please find the following task examples: *Greenhouse gas* in connection with real computer aided experiment.

Confirmation research

Execute an experiment with the title *Greenhouse gas*. Experiment is made to confirm data you were provided with in the class. It is important to learn to work effectively with sensors and to carry out computer aided experiment to validate the result know in advance. On the level of confirmatory research pupils know the procedure of the experiment and they are theoretically prepared in advance. Experiment with carbon dioxide as a greenhouse gas is described in advance. Pupils know the answers to the questions before they start performing the experiment itself.

Structured research

Please execute the following experiment titled *Greenhouse gas*. Inform all students in your class about the result of the experiment. Evaluate on your discovery. Specify why you made the particular experiment. It is assumed that the student works with the result he/she obtained during the experiment. It is not enough to execute an experiment and compare gained data with the results given in advance but to interpret all measured data correctly. Based on structured research, pupils know the procedure of given experiment but the difference is that they have to find out themselves why they did the experiment and to come up with the conclusion. They are prepared theoretically, so that after performing the experiment they are apt to explain the issue.

Guided research

Please execute an experiment to prove that *greenhouse gases cause planet warming*. Please suggest an experiment. Please suggest the method of executing the experiment. Inform all students in your class about the result of the experiment. Were all your hypotheses you made before executing the experiment confirmed? Are you surprised by the result? The student specifies his/her own method and sets the sensors, technologies if needed, he/she could use. The teacher gives him/her advice, guides him/her and discusses his/her choice. The method is given by the student. This level of research based teaching assumes the student is able to choose the technologies offered by school and is able to solicit them. Based on structured research, pupils know the procedure of given experiment but the difference is that they have to find out themselves why they did the experiment and to come up with the conclusion. They are prepared theoretically, so that after performing the experiment they are apt to explain the issue.

Open research

Please individually prepare experiment(s) that are connected with the topic *Greenhouse gases as a part of atmosphere*. What is the scope of your investigation? What would you like to look for? Is it possible to find the above stated information with the scope of opportunities given by school? Are there other possibilities how to find out introduced suggestions behind the school? Are there technologies and machines that can help you? How the mentioned technologies work? The student does not have any restrictions concerning the choice of the experiment or its execution, however the teacher provides support and guidance. The student also has to prepare and plan the experiment and chose the technologies. On level on opened research pupils working with greenhouse gases topic and carbon dioxide ask questions and create hypotheses. They think of procedures and suggest the experiment method and perform it.

Conclusion

Contemporary concept of biological and environmental education on primary schools provides suitable conditions to use IBE with ICT support, which should lead pupils to understand the essence of phenomenon and issues that exist in their surroundings. The teacher disposes of documents and theoretical resources for work in class. It is important to put them into practice in a way that leads towards necessary understanding of pupils.

Information and communicative technologies have a place in Inquiry-Based Science Education. New technologies give teachers and students various opportunities to solve problematic tasks and to make experiments that can get completely new dimension. There are more methods available for the participants to approach the technologies – ICT activities and Inquiry-Based Science Education. ICT are very often applied in practice. Didactic materials for ICT in teaching have been already prepared for Environmental education. Examples mentioned above prove, that students gain skills of using ICT in particular levels of research (confirming, structured, guided, open) when applying concrete research oriented teaching.

References

ALTMANOVÁ, Jitka a kol. *Gramotnosti ve vzdělávání: příručka pro učitele.* Praha: Výzkumný ústav pedagogický v Praze, 2010, 68 s. ISBN 978-808-7000-410.

BELL, Randy., Lara SMETANA and Ian BINNS. Simplifying inquiry instruction. *The Science Teacher*. 2005, roč. 72, č. 7, s. 30-34.

BÍLEK, Martin, Jiří RYCHTERA and Antonín SLABÝ. *Konstruktivismus ve výuce přírodovědných předmětů*. 1. vyd. Olomouc: Univerzita Palackého v Olomouci, 2008, 31 s. ISBN 978-80-244-1882-7.

EASTWELL, Peter. Inquiry learning: Elements of confusion and frustration. *The american biology teacher*. 2009, roč. 71, č. 5, s. 263-264.

KUBICOVÁ, Svatava and Jana PŘINOSILOVÁ. Inquiry-Based Science Education with the support of ICT in Environmental Education. In: *Information and Communication Technology in Education: Ph.D. student´s section*. University of Ostrava, 2011, s. 453-456. ISBN 978-80-7368-979-7.

MAŇÁK, Josef and Vlastimil ŠVEC. *Výukové metody*. Brno: Paido, 2003, 219 s. ISBN 80-731-5039-5..

MARTINEC, Lubomír, Jan HUČÍN, Lucie KELBLOVÁ, Zdeněk MODRÁČEK and MOKRÁ. *Co umí čeští žáci?: Výzkum PISA*. UIV - divize Tauris: Tauris (UIV), 2008. Určeno našim učitelům. ISBN 978-80-211-0555.

MECHLOVÁ, Erika and Jana PŘINOSILOVÁ. ICT on four levels of Inquiry-Based Science Education in Environmental Education In: *Information and Communication Technology in Education*. University of Ostrava, 2012, s. 185-191. ISBN 978-80-7464-135-0.

STUCHLÍKOVÁ, Ivana. O badatelsky orientovaném vyučování. In: *DiBi 2010: didaktika biologie v České republice 2010 a badatelsky orientované vyučování : sborník příspěvků semináře 25. a 26. března 2010*. V Českých Budějovicích: Jihočeská univerzita, 2010, s. 129-135. DOI: 978-80-7394-210-6.

PALEČKOVÁ, Jana, Vladislav TOMÁŠEK and Josef BASL. *Hlavní zjištění výzkumu PISA 2009: umíme ještě číst?*. 1. vyd. Praha: Ústav pro informace ve vzdělávání, 2010, 51 s. ISBN 978-80-211-0608-6.

Rámcový vzdělávací program pro základní vzdělávání. Vyd. 1. Stařeč: INFRA, 2005, 113 s. ISBN 80-866-6624-7.

ROSECKÁ, Zdena, Jiří RYCHTERA and Antonín SLABÝ. *Malá didaktika činnostního učení: [praktická příručka pro učitele a rodiče žáků základních škol, kteří mají zájem poznat české činnostní učení v pojetí Modelového školního vzdělávacího programu Tvořivá škola]*. 2., upr. a dopl. vyd. Brno: Tvořivá škola, 2006, 98 s. ISBN 80-903-3972-7.

PŘINOSILOVÁ, Jana. Badatelsky orientovaná výuka s podporou ICT na základní škole. In: *AKTUÁLNÍ PROBLÉMY PEDAGOGIKY VE VÝZKUMECH STUDENTŮ DOKTORSKÝCH STUDIJNÍCH PROGRAMŮ IX.: Sborník příspěvků z IX. ročníku konference konané dne 1. prosince 2011*. Olomouc: Societas Olomoucensis II, 2012, s. 125-130. ISBN 978-80-87533-03-1.

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ANALYSIS OF CHILDREN'S PROFESSIONAL ORIENTATION AT SENIOR PRIMARY GRADE

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Abstract

The article summarizes fundamental facts of a part of the research project that was focused on pupils' professional orientation and on technical and practical competence of pupils at senior primary grade of the schools within Moravian-Silesian County. The research was executed by means of on-line data collection provided by Methodical and Evaluation Centre o.p.s. in 2008 and 2009. The data analysis of the results of General Interest Structure Test (AIST-R test), which deals with the professional orientation, demonstrated an interesting structure of pupils' professional orientation. The pupils from 6th up to 8th classes were examined. We obtained preferences of the interests structure, the most sought combinations of career selection, aspiration levels of reached education and all that for about 1,600 pupils. This internationally proven test in a computational version was used continually with a newly constructed achievement method for finding out aptitudes linked with technical and practical competence (TTPP - Test of Technical and Practical Competence). The results that foreshadow possibilities of pupils' professional aiming might become a useful tool of their motivation then.

Keywords

Occupational choice, General Interest Structure Test (AIST-R), professional orientation, Test of Technical and Practical Competence (TTPP), Questionnaire of Attitude towards Science and Technology (DVTZ), Moravian-Silesian County

Introduction

For the time being, there is information available on insufficient interest in professions dealing with manual labour, skilled craftsmen's work or on a total departure from the branches that are focused on the technique and technically and practice-oriented professions. According to the media, apprentice schools, secondary technical schools but also schools of tertiary education in technical branches including IT technologies have problems. According to the information from practice, we are aware of the fact that there is a shortage of design engineers, electrical

engineers, mechanical engineers or civil mechanical engineers. Some huge companies even notify of a need of ten thousand of skilled employees in a horizon of the next ten years. From a point of view of the employers neither situation at the labour market improved by the present crisis even if the overhang of the demand above the offer slightly decreased as regards the working positions in technical professions. However, this situation can be preventively secured earlier than the working market variability collapses thanks to satisfying of inadequate ambitions by means of the education which does not correspond to aptitudes of students. Even if such students graduate from the school, they won't be able to assert themselves in corresponding job positions. Ever since beginning of the school attendance, there are many children who are motivated in order that they did very well at school to avoid a job with a share of manual labour. It means that such children are motivated to obtain a job that is rather connected with paperwork or work in the sphere of business. If such student graduates e.g. from a college focused on entrepreneurial activities and gains „Dis." title, it must be a shock from him/her to work at a position of a stock keeper in a supermarket because of a lack of professional possibilities. Noncompliance with student's professional interests and real aptitudes and unsuitable profession routing must be blamed.

Research Questions

We are aware of the fact that within the population there are people with predispositions for various activities. We also have tools available how to find out their aptitudes and preferences. Despite that there are not many eventualities against the influence of actual attractive career trends by which pupils might be influenced regardless of their dispositions and interests. However, we may develop diagnostics, work out more precise predictions, and help to develop potential that they have. And also we may investigate where and what kind of subsequent coherences are, respectively on the base of these researches we may revise information in the media. So, we have appointed several questions then:

- What professional orientations do pupils prefer at the senior primary grade?
- Which kinds of tendencies dominate?
- What ambitions of subsequent education do children have?
- How is the inclination to a life style formed in relation to the increasing age?
- Are the results of AIST-R test comparable with the results of other testing methods?

File

For the research needs, from the aspect of harmonious regional distribution, we have chosen 17 schools, resp. 87 classes in the Moravian Silesian Region in the CR. The schools were located in small villages as well as in large towns (see Table 1). (Industrial specificity of this region must be considered as a limiting factor for all republic generalisations.) Submission of a school was limited by its minimal computer equipment. In total, 1,650 pupils of senior primary grades aged from 12 to 16 years were tested. Children participation in the research was voluntary, and

within school classes. Schools' principal ship was informed on the investigative targets of the research beforehand. The children were not motivated by any rewards.

From the total file, the incomplete data or the data created by a non standard way were excluded consequently. After exclusion of these data, the complete file was created that counts 1,605 pupils. The resulting file contains the boys (n = 787, 6th-8th grade, aged from 12 to 16 years), and the girls (n = 818, 6th-8th grade, aged from 12 to 16 years) (see Table 2). Average age of the pupils in the individual classes between the girls and the boys is stated in Table 3 (Badošek, Kimplová, Mynářová, 2012). Because of the fact that some tested files might be used separately for the statistic purposes, it means without a relationship to the subsequent data, we might meet some small differences within the text as regards a total number of respondents e.g. (n = 1616) or similar.

Geographic Composition of Whole Sample		
Municipality Size	n	%
Number of People less than 10,000 Inhabitants	747	45
Number of People more than 10,000 Inhabitants	903	55

Tab. 1: Location of school

Age	Boys	Girls
12	112	149
13	229	263
14	262	285
15	172	111
16	12	10
Total	787	818
	1605	

Tab. 2: Numbers of children

Number of Pupils (n) and their average age (M) according to gender and school class membership (the sample without non standard data)

	6th class	7th class	8th class
Boys n =	242.00	263.00	282.00
Boys M =	12.59	13.62	14.66

Girls n =	277.00	281.00	260.00
Girls M =	12.49	13.52	14.48

Tab. 3: Average age of the pupils

Methods and Results

General Interest Structure Test (AIST-R, Allgemeiner Interessen-Struktur-Test)

During the executed research (Badošek, Kimplová, Mynářová, 2012), we obtained a lot of data. We analysed the data consequently by the item analysis and compared them with the other data obtained from different researches. By means of the AIST-R Test (Testcentrum – Hogrefe, Praha, 2006), we evaluated both the inclination to a certain type of personality connected with orientation on a life style according to Holland's Theory (1966) (In Mezera, 2006) and also pupils' aspiration in consequent education. Another possibility how to gain useful information was to evaluate the data obtained from this test that have not been investigated yet. It means, for example, to evaluate the data dealing with the amount of intertype triples of the letters expressing pupil's professional orientation.

Holland created a hexagonal model that contains the following scales at its apexes: R, I, A, S, E, C.

R A realistic type of a person who prefers to work with technical objects or machines, who is skilled in crafts and conservative

I A person who likes to observe, learn, investigate, analyse, a person who is fond of accuracy and logics

A A person with artistic aptitude, for who aesthetics is of value, and who likes to work in situations using his/her creativity, and freethinking

S A person of social type, friendly people who are willing to help other people, and enjoy a contact with them

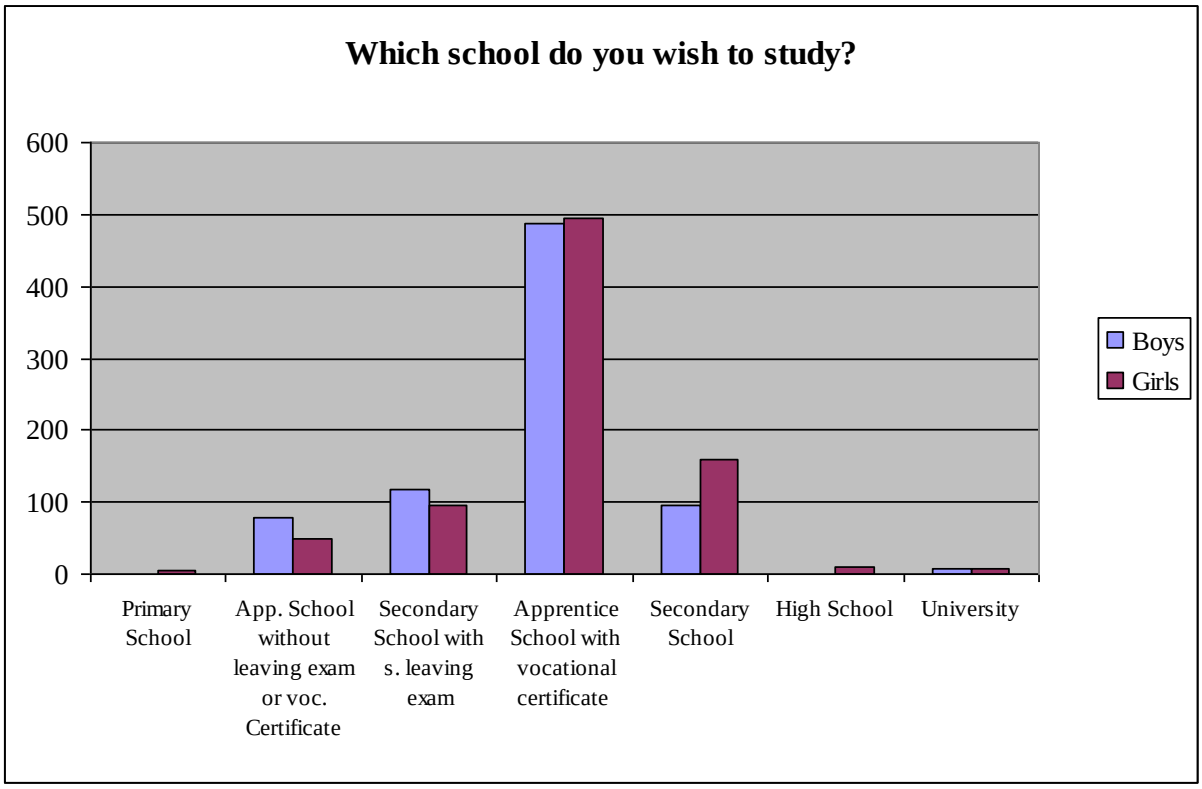
E Persons of this type are enterprising and active. They like to work with people persuading, leading and organizing them. They are focused on success, or economic gains. They are independent with a higher readiness to risk.

C A conventional type of a person. Rules and organised activities are important for them.

If an individual gains the highest score in one from these groups, this is a dominant life style that brings along also a related choice of a profession that complies with him/her. Hlaďo (2009, p. 27) says: „Holland (1966) originally presumed that every individual always belongs to the only from the six types of personality. However, he leaves this presumption in his revised theory and claims that despite of the fact that one type usually dominates, a person does not have to pertain to some from the stated types exclusively but usually he/she is characterised by a certain intertype“. Therefore he selected the first three scales with the higher number of reached points that create a certain code, for example RIA. If a pupil does not have too big difference in a

number of points (according to the table of critical differences) (Boschek, 2006) (In Mezera, 2006) among the individual scales, the code might be extended to 6 positions: for example RIA/RAS or also to 9 positions: RIA/RAS/RAC. In an extreme case the system generates up to four combinations of the codes: SEC/SCE/ESC/CES.

According to Holland, the professional orientation and job selection is in progress in several development periods during the course of which a pupil gradually selects one or more professional groups of jobs. Because of that we might assume that pupils will incline more to one type when they grow up and this type will gradually become dominant. The older pupils are, the shorter codes should be and they should correlate negatively. However, the resulting correlation r = 0.021 (n = 1,605) from our research does not demonstrate that. If we interpret it, the age does not play any role in a more specific differentiation of a certain type of professional orientation. Certainly, even if the examined sample is large, we might not accept these data at their face value because a longitudinal aspect was not considered – only the age variables were taken into account so gradual differentiation of an individual pupil cannot occur. Respectively, a lead ahead in development occurs another time than at the age of the monitored population of the pupils from the 6th to 8th classes. It can be claimed only that the differentiation did not occur within this period. We also expected an effort to shorten the code because of the increasing pressure to select a course of the subsequent education. However, it might be possible that everything is solved in the situation of time pressure. It means in the 9th class that was not included in the testing. Or pupils of this age do not have strong vision yet and, on the contrary, wider interests enable them to solve situation of non specific decisions „which next school to choose".



Graph 1: School ambitions

Further to the previous hypothesis on differentiation, our next investigated object was pupils' aspiration in a type of school for the next education. It is one from the first questions in the AIST-R questionnaire. We were interested in the fact whether representation of the individual types of schools will differentiate according to the gender. We did not determine any expected results for this question. We viewed this as a mapping indicator only. We can see the results in Graph 1.

If we understand the question to the extent that it deals with the closest education not with the absolute level of the education, we can assign grammar schools in a form of an automatic base for university education to the universities and colleges. Then we will get a part of population at the senior primary schools that have ambitions to reach the highest level of the education. This population amounts to 16.2%. Within the statistics, this value is very close to our definition of the above average value. Columns in the middle of the graph demonstrate a fixed pillar of the education at the secondary schools with the school-leaving examination (984 pupils in total from the sample of 1,616). It deals with a more practice-oriented education. If we try to guess differences between the genders, we find out a fundamental difference in the aspiration for grammar schools where the girls have higher representation by 68%. If we compare this piece of information in the context with the data obtained further (e.g. a preference in the code according to a gender that shows a different orientation of the girls and of the boys), we might find out reasons why there is a lack of technically oriented university female students.

The last examined element dealt with a global detection of the most often used type at the position 1 – 6 (it means that only codes with maximally 6 elements were considered – e.g. RIA/RAI) in an unsorted file. However, we monitored also frequency within the sorted file according to the gender that is a quite important gender variable for the professional orientation (Badošek, Biolek, Kimplová, 2009). In that case, due to lucidity, we state the first 3 positions in the code only.

At first sight, the results were striking. Because despite of all the information from the media and practice that deals with a lack of „technicians", R scale has been stated the most often on the first position in the unsorted file. RIA/RAI – is the code that contains a dominance of practical approach and manual work by not isolated testees. The orientation on science, analytical and investigative orientations or artistic orientations that are on the contrary undisciplined and freely creative follow. See the detailed data in Table 4. You can see analogous data in the following code, it means at the positions from 4 up to 6 in Table 5. Again the most preferred scale was R scale followed by A scale at the next position (even if the R scale is de facto presented most, it cannot be repeated in the code). S and E scales are at the last position with a minimal difference. The average pupil's second code in the order should be the following one: RAS or RAE. Again a realistic style leads, respectively with a quite high numerical superiority.

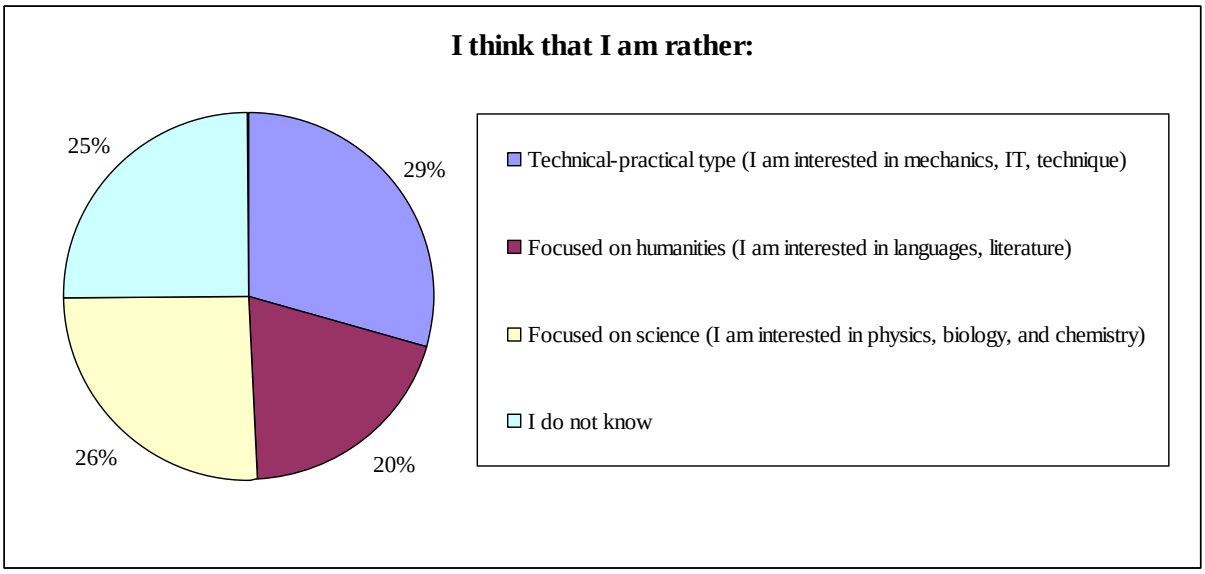
Scale	Frequency at 1st position	Frequency at 2nd position	Frequency at 3rd position
R	**538**	317	295
I	276	**369**	**370**
A	444	**354**	**342**
S	159	220	237
E	119	206	216
C	80	150	156

Tab. 4: Frequency at position 1st–3rd

Scale	Frequency at 4th position	Frequency at 5th position	Frequency at 6th position
R	**572**	461	304
I	208	284	234
A	378	**303**	245
S	176	164	**305**
E	131	191	**291**
C	151	213	237

Tab. 5: Frequency at position 4th–6th

Global results demonstrate that the pupils do not have aversion towards practical activities, they do not mind working outside, respectively with animals or with tools. Where is the problem then? Does AIST-R test generate inadequate results? We are persuaded that not at all. Within a similar research, we have created an original questionnaire that deals with monitoring of scientific and technical interests – DVTZ (DVTZ – Questionnaire of Scientific and Technical Interests). We used this questionnaire to test other 1,050 pupils and students (Badošek, Kimplová, 2010). One of the questions was also the question on self-rating and self-classification to the types: technical-practical, relating to natural science, relating to humanities and also a pending answer of „I do not know" was left in it. The following classification was found out at the primary schools (n = 639) (Graph 2).



Graph 2: Self-classification

On the base of these results, even if it is a partial result, we presume to support the idea that the situation with preferences of the technically oriented professions is not by a long sight so bad and that AIST-R data really correspond to the reality. Enthusiasm to put something in mind is not an important variable. We think that a decisive influence is caused by another factor or factors. Although we might just presuppose even if it was logical that parents' influence might play a role together with inordinate media pressure. So we should give a thought to the fact how effective psychological activity is in reality.

Also classification of the results according to the gender is interesting. It is stated in Table 6 and Table 7. The results in total completely differ from the results according to classification of the individual components. It appears that the girls absolutely uniquely prefer A scale that is dominant for them and that means artistic inclinations, the interest in beauty, aesthetics, and emotional harmonization. However, on the other side, neither R scale is out of mind because it is on the second position. The last position is occupied by I scale. The most typical formula of the girls would be the following: ARI. For the boys the realistic style (R) is in charge on the first position. Investigative style (I) is on the second position and artistic style (A) is on the third position. The most typical formula was RIA. On the base of other experiences, we would expect higher representation of the social scale (S) for the girls but it is not the case.

Boys			
Scale	Frequency at 1st position	Frequency at 2nd position	Frequency at 3rd position
R	**352**	136	104
I	158	**214**	194
A	131	172	**186**

S	57	103	117
E	66	97	107
C	30	72	86

Tab. 6: Frequency at position 1st -3rd boys

Girls			
Scale:	Frequency at 1st position	Frequency at 2nd position	Frequency at 3rd position
R	186	**181**	191
I	118	155	**176**
A	**313**	182	156
S	102	117	120
E	53	109	109
C	50	78	70

Tab. 7: Frequency at position 1st -3rd girls

It seams that the girls want less socially oriented preferences than they should have received on the base of a currently used point of view in the community (simply there is less of the girls who want to be e.g. a nurse). We do not know whether it is a standard and permanent phenomenon or whether it is a proof of borders balancing but if we have an opportunity we would like to find it out in our next research.

Test of Technical-Practical Competence (TTPP):

This test was constructed as a screening method for evaluation of technical-practical aptitudes. It deals with a newly created test investigating technical-practical competence. It consists of 30 pictorial tasks that require comprehension of basic mechanical and physical relations. The experimentees choose one correct answer from a few possibilities. It comes from a concept of several tests that were constructed in the past (Miglierini, 1991). It contains simple physical and practical tasks from different areas (friction, pressure, stability, rolling resistance, lever, or similar). (Kimpl, Badošek, Kimplová, 2009) (In Badošek, Biolek, Kimplová, 2009).

Test reliability was verified on pupils (n = 67) within a pilot research. The research was executed by a system of test-retest within the interval of 10 months. The test demonstrates reliability r = 0.76. We might assume that the reliability meets requirements put on the stability in time. Content validity is adequate considering achievement character of the test and its pedagogical orientation (the test contains modified tasks from discussed content of the curriculum that pupils must correctly apply; it is not enough just to remember it).

We expected that the pupils who are interested in technically or practically oriented professions, what was found out according to the AIST-R test, will reach higher score also in this achievement test in accordance with the consideration: a person who is interested in a technical profession must be successful in it and has to understand it. The results were not so noticeable; however, they exist in statistic level even if a practical applicability of the correlations, which are stated further, is insignificant, see Table 8. Even though, we found out some significant correlations. It is valid that for n = 1,605; r crit. = 0.0643; p<0.01.

	TTTP
R	0.13
I	0.14
A	-0.06
S	-0.11
E	0.002
C	-0.02

Tab. 8: Correlation TTPP

BTZS	Spatial Imagination	Visual Perception	Arithmetics	Verbal Aptitudes
TTPP	0.40	0.32	0.29	0.32

Tab. 9: Correlation BTZS and TTPP

On the other side, it makes sense that children who reach good achievements in the TTPP test correlate positively with R and I scales (Realistic, Investigative) and negatively with S scale (Social).

Higher correlations were demonstrated if compared with parts of a Czech version of the BTZS test (Test Battery of Basic Aptitude) – originally GATB Test (General Aptitude Test Battery) (Vašina, Komárková, 1975). The achievement within this test correlates with spatial imagination (r = 0.4; p<0.01) the most and further with verbal (r = 0.32; p<0.01) and mathematical (r = 0.29; p<0.01) aptitudes. See detailed results above in Table 9. To a great extent, the success in TTPP test is saturated by intellectual aptitudes. However, according to our experience, it was often demonstrated that the pupils who reached good achievement in the TTPP test (and by that also a link with higher intelligence) and who should have inclined to technical branches were not interested in this area. This finding corresponds to Holland's opinion (1966) (In Mezera, 2006) that interests are more important for the motivation to a certain profession than the intelligence.

Conclusion

Because of a specific region that is well-known by its industrial production, even if a number of respondents was quite high, we mustn't consider the results too seriously and we cannot apply them for the whole Czech Republic. Despite of that, the results indicate preferences of technical and practical professions in both the questionnaires, it means within the AIST-R test and within the DVTZ test. This fact is contrary to the declared lack of interest in technical professions.

There is a modest coherence between the interest in practical activities and achievement in technical tasks. The same as there is a coherence between the aptitude to solve technical-practical tasks and individual elements of the intelligence. Unfortunately, all the links are admittedly valid from a point of view of the statistics but from the aspect of practical utilization, it deals with solitary elements that have an influence in the complex evaluation of the following triple only:

1. Specific aptitudes;
2. Interest;
3. Intelligence.

Deduction on the base of one of them only won't lead to good results.

With regard to school ambitions, from the aspect of Gaussian distribution of aptitudes within the population, we consider a ratio of children who incline to the highest education adequate.

Already AIST-R standards themselves indicate that the girls prefer artistic direction more than the boys within this questionnaire. It does not mean that the girls do not have enough aptitudes for the technical or scientifically oriented professions (if compared by Badošek, Kimplová, Mynářová, 2012) but they are interested in the given professional orientation less or even not at all.

According to us, there are several contradictions: between the aptitudes and the interests, between the interests declared in the tests and pupil's presence at corresponding fields of study or apprenticeship and between that what children want and that what they will do finally. There are many variables: media, wider neighbourhood, family, parents, often friends, fashionable tendencies or sociologic changes in the community.

References

BADOŠEK, Radim, Marek BIOLEK a Tereza KIMPLOVÁ. *Metodika k realizaci testování: Technický talent.* [Methodology to Realisation of Testing: Technical Talent] Ostrava, 2009. Ostrava University.

BADOŠEK, Radim a Tereza KIMPLOVÁ. *Psychologické testování žáků na ZŠ. Projekt: Systém využití počítačem podporovaných experimentů k posilování výzkumných kompetencí žáků základních a středních škol (CZ.1.07/2.3.00/09.0024)* [Psychological Testing of Pupils at Primary Schools Project: Computer Aided Experimental System for Fortification of Primary

Grade Pupils and Secondary Grade Students Research Competences (CZ.1.07/2.3.00/09.0024)] Ostrava, 2010. Ostrava University.

BADOŠEK, Radim, Tereza KIMPLOVÁ a Jana MYNÁŘOVÁ. The Technical Competence and Technical Profession Preference of Boys and Girls in the Czech Republic. *The New Educational Review*. 2012, roč. 27, s. 133-146. ISSN 1732-6729.

HLAĎO, Petr. *Volba další vzdělávací dráhy žáků základních škol v kontextu rodiny.* [Primary Grade Pupils' Selection of Other Education in Family Context] Brno: Masaryk University, 2006. Unpublished doctoral thesis.

MEZERA, Antonín. *Příručka pro uživatele Test struktury zájmů (AIST-R).* [User's Manual for Test of Interests Structure (AIST-R (Allgemeiner Interessen-Struktur-Test))] Prague: Testcentrum – Hogrefe, 2006.

MIGLIERINI, Bruno. *Test technického myslenia.* [Technical Thinking Test.] Bratislava: Psychodiagnostické a didaktické testy: š.p. 1991.

VAŠINA, Bohumi a Eva KOMÁRKOVÁ. *Závěrečná zpráva o výsledcích řešení výzkumného úkolu, součásti výzkumného úkolu 8/2 Ministerstva školství ČSR „Ověření baterie testů základních schopností – českého převodu GATB – jako psychologické diagnostické metody pro školní a profesionální poradenství"* [Final report on research task solution results, part of research project 8/2 Ministry of Education CSR „Verification of General Aptitude Test Battery – Czech Application of GATB – as psychological diagnostic method for school and professional guidance"] Ostrava, 1975.

OSTRAVA WORLD OF TECHNOLOGY EDUCATIONAL CENTER

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Introduction

The former iron processing and manufacturing center in the Lower Area of Vítkovice in the Ostrava region, which was closed down in 1999, is now a National Cultural Monument. The plan is to use its premises in a new way. As a result, the entire area is becoming a unique place of culture, social events, and education.

New conference and congress premises have been built in the reconstructed gasholder built in 1924. Besides the "Gong" hall, which is the present name of the gasholder, the building of the former 6th Energy Central Station has also been reconstructed. In the building there is the interactive U6 Science Museum U6 and the U6 training center – "The Small World of Technology". Behind the original building a brand new building for the *World of Technology – Science and Technology Center* is being built. This will become a popular science center that will make science, research, and technological fields more accessible.

U6 Museum Exhibition

The U6 interactive exhibition – Technology Exhibition for All Age Groups – is situated in the large and masterfully used premises of the former 6th Energy Central Station. The scenario of the exhibition is closely connected with both the history and present of the industrial area of Vítkovice. All of the eight sections of the exhibition, which are inspired by Jules Verne's adventurous books, present the development, innovation, and modernization of technologies and the essential impact they had on the development of industry. The exhibition that is focused on the gradual transition from machines operated by people to steam engines and electric combustion engines serves as one example.

A guide walks the visitors through the exhibition and describes the particular technological periods and their connection to the development of industry and the entire society. The story of the weaver's loom can serve as one example: to meet the large demand for fabrics and to make quicker and more effective work possible, the technology and techniques had to be revolutionized. The exhibition is further centered on the industrial revolution and steam engines, manufacturing and processing of iron, generation of electric power, acoustics and oscillation, water-turbines, aviation, and astronautics.

The exhibition allows the visitors to physically interact with the exhibits. There are mechanical models, levers, pulleys, models of the steel processing, or motorcycle, automobile and aviation simulators at their disposal. To mention some of the attractive exhibits: the Nautilus submarine, the engine of the MiG-21 jet, or a locomotive engine room.

U6 Training Center

Besides the interactive exhibition, there are also classrooms of the educational and demonstrational center "The Small World of Technology". Free education of the second level elementary school students and students of high schools takes place in the classrooms. The three-hour accredited educational blocks offer an interesting teaching method of mathematics, physics, chemistry, biology or ICT. The latest educational tools, such as animation or simulation, are part of the education process. Tablets, interactive boards, and touch screen or 3D televisions are also part of the equipment of the classrooms. The Advee and LEGO Mindstorms robots provide both entertainment and information.

Besides the lessons for pupils and students, there are also free certified education trainings for the pedagogues. The programs are centered on the more effective use of ICT in the teaching process and the popularization (in the form of an entertaining form) of the natural science subjects.

World of Technology – Science and Technology Center are the premises that are being built behind the U6 building. The goal of the project is to revitalize the Lower Area of Vítkovice. The goal should be accomplished by establishing the popular science center for kindergartens, schools, and the general public. The center will have interactive exhibits, the purpose of which is to explain (in an entertaining and comprehensible way) to visitors the world around us. Completion of the building and its opening is planned for the fall 2014.

ICT Educational Modules

Under the supervision of the warrantor Jana Kapounová, the employees and students of the ICT department of the Pedagogical Faculty of the University of Ostrava have participated in the creation of educational courses for the pedagogues of elementary and high schools. These courses are centered mainly on the use of the ICT as an innovative and interesting teaching method. The educational modules are designed to help teachers master the digital technologies and incorporate the acquired methods into the teaching process.

The modules deal with office software, freely available graphic software, cloud computing, school magazine editorial system, and computer network security. The form of education is individual depending on the particular course. However, the most common forms are the full-time education, the dialog-based education, or the computer-supported education.

More Beautiful Microsoft Office

The course is aimed at the basics of Microsoft Word and Excel. A number of practical examples, such as formatting of the classification sheet, are part of the course. Lukáš Noskievič is the author of the module.

Secret of Curves

The course is aimed at work with computer graphics. The lecture is centered on the principles of raster and vector graphic. The course includes working with the freely available vector graphic editor Inkscape. Tomáš Javorčík is the author of the module.

Cloud Computing Made Easy with Google Tools

Google offers a broad spectrum of office software that uses the possibilities of information sharing on the Internet. These applications can be used for more effective team work at school. The aim of the course is to clarify the meaning of Cloud Computing and present the advantages and limits of its practical application by both teachers and students. Pavel Kapoun is the author of the module.

School Magazine with Wordpress, Quick and Easy

In the course teachers become acquainted with the ways of creating an online version of the school magazine with the help of the WordPress editorial system. The lecture is further aimed at the work of the editor's office, particular user roles (administrator, editor, reader) and the possibility of students' engagement in the editorial board. Jiří Hoffmann is the author of the module.

Network Security

The latest of the six accredited courses for pedagogues is the module centered on the essence of dangerous cyber phenomena and the Internet security. The lecture is focused on computer criminality, encryption, software handling sensitive data, and useful advice on the right configuration and security of the WiFi network. Tomáš Javorčík is the author of the module.

Conclusion

The Ostrava World of Technology Educational Center is at the beginning of its activity and the main goals still lies ahead of it. Moreover, the cooperation between the Center and the ICT department of the Pedagogical Faculty of the University of Ostrava is evolving, too. There are countless possibilities to utilize the ICT in the extracurricular and supplementary education, be it in didactic games or in museum pedagogy. It is a question of creative ideas. Considering the courses that are focused directly on the teaching of the ICT, now in the time of multimedia there is an enormous demand for vector and raster graphic, digital photography, and video and sound editing. These are the points of further cooperation between the University and the Center.

References

Svět techniky: Science and Technology Center Ostrava [online]. 2012 [cit. 2013-04-16]. Retrievable from: http://svet-techniky-ostrava.cz/cs

Náš projekt - Svět techniky. *Svět techniky: Science and Technology Center Ostrava* [online]. 2012 [cit. 2013-04-16]. Retrievable from: http://svet-techniky-ostrava.cz/cs/nas-projekt

Multifunkční aula GONG: Dolní Vítkovice (plynojem). *Dolní oblast Vítkovice* [online]. 2010 [cit. 2013-04-16]. Retrievable from: http://www.dolnioblastvitkovice.cz/36/cs/node/2482

Malý Svět techniky v Ostravě otevírá. *Svět techniky: Science and Technology Center Ostrava* [online]. 2012 [cit. 2013-04-16]. Retrievable from: http://svet-techniky-ostrava.cz/cs/maly-svet-techniky-v-ostrave-otevira-skolaky-vita-robot-advee-a-desitky-novych-moznosti-jak-poznat-vedu-a-techniku

Expozice U6. *Svět techniky: Science and Technology Center Ostrava* [online]. 2012 [cit. 2013-04-16]. Retrievable from: http://svet-techniky-ostrava.cz/cs/expozice-u6

Nabídka pro školy. *Svět techniky: Science and Technology Center Ostrava* [online]. 2012 [cit. 2013-04-16]. Retrievable from: http://svet-techniky-ostrava.cz/cs/nabidka-pro-skoly

Department of ICT: Pedagogical faculty, University of Ostrava [online]. 2013 [cit. 2013-04-16]. Retrievable from: http://pdf.osu.eu/kik/