CONTENT

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Scientific journal of the Czech University of Life Sciences Prague JOURNAL ON EFFICIENCY AND RESPONSIBILITY IN EDUCATION AND SCIENCE, distributed by the Faculty of Economics and Management. Published quarterly. Executive editor: doc. Ing. Milan Houška, Ph.D., Editorial Office**:** ERIES Journal, Czech University of Life Sciences Prague, CZ 165 21 Prague 6 - Suchdol, Czech Republic, email: editor@eriesjournal.com, tel: +420 22438 2355.

ERIES JOURNAL

ERIES Journal

JOURNAL ON EFFICIENCY AND RESPONSIBILITY IN EDUCATION AND SCIENCE

VOLUME 7

ISSUE 2

An international peer-reviewed journal published by
Faculty of Economics and Management
Czech University of Life Sciences Prague

contact: editor@eriesjournal.com
www.eriesjournal.com
Online ISSN: 1803-1617
Printed ISSN: 2336-2375

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EDITORIAL

In June 5th and 6th 2014, the 11th conference on Efficiency and Responsibility in Education (ERIE) was held at the Faculty of Economics and Management, Czech University of Life Sciences Prague. The conference ERIE 2014 attracted more than 120 participants from various public and private education institutions either from the Czech Republic or from abroad. This increasing number of contributors confirmed the quality and increasing prestige of the conference ERIE in the field of education. Many articles from the past years of ERIE conferences have been elaborated to the ERIES Journal and some of them are published in this issue as well.

This current issue of the ERIES Journal, which you hold in your hands, includes articles from University of Ostrava, South-West University "Neofit Rilski" in Bulgaria, University of Hradec Kralove and Aksaray University in Turkey.

Authors Katerina Kostolanyova and Stepanka Nedbalova, both from University of Ostrava, discuss a possible usage of adaptive e-learning in a language learning to sensory modalities application in a language learning diagnostics. For this purpose, the authors present a design of diagnostic placement test, together with characteristics of testing tasks. Moreover, the authors gathered in total 130 psychological questionnaires from students. As a result, the authors find out that psychological questionnaires are not suitable tool for sensory modalities of students. Therefore, designed diagnostic placement test is considered as a more relevant tool.

Tatiana Shopova from South-West University "Neofit Rilski" presents an article related to the problems of effective usage of new information and communication technologies in education and training. The author focuses on the key role of digital literacy and students´ skills to use new technologies. The article is based on a conducted survey among 60 first- and second-year students, which used the method of direct personal inquiry through pre-designed questionnaires. The results show that improving students´ digital literacy is an important condition for the successful performance and achieving better results in the learning process.

Eva Widenska from University of Hradec Kralove brings a pedagogical experiment focusing on effectiveness of utilisation of exercise materials using ICT and classical printed materials in mathematics teaching. This research consists of 559 students from the first semester of study and was held at the Faculty of Chemical Technology, University of Pardubice in the academic year 2012-2013. The author also compares study results' differences between students who participated in the experiment and those who did not participated.

Huseyin Unlu, Emin Suel, and Murat Erdogdu from Aksaray University investigate the computer self-efficacy of Turkish prospective physical education teachers. Their research group consists of 173 physical education teachers who were enrolled in various years of physical education and sport teaching programmes. The research took place at three different universities during the school year 2010-2011. Results indicate that physical education teachers obtained high computer self-efficacy scores. Moreover, the authors also analyse differences between genders, class year, and teachers´ ages. No significant differences were found.

We hope that all our readers will find this second issue of the year 2014 and all the articles mentioned above interesting. As in the previous issue, we are glad that the ERIES Journal constantly attracts researchers, academics and authors from various institutions and countries. Last but not least, we would like to thank all the authors, reviewers, and the Editorial board members who have contributed in increasing the ERIES Journal quality.

Sincerely,

prof. RNDr. Jaroslav Havlíček, CSc.

Editor-in-Chief

DIGITAL LITERACY OF STUDENTS AND ITS IMPROVEMENT AT THE UNIVERSITY

Tatiana Shopova
South-West University "Neofit Rilski" Blagoevgrad

Highlights

- *The research focuses on the level of students` digital literacy at the South-West University.*
- *The conducted analysis is supported by empirical data.*
- *The research shows the role of University for improving students` digital competence.*

Abstract

In response to the problems related to the effective use of new information and communication technologies (ICT) in education and training, this paper focuses on the key role of digital literacy and the skills of students to use new technology that will have an increasing role in the integration in the European Higher Education Area. The development of the literacy level of students and their digital competence is crucial for improving the effectiveness and efficiency of the learning process as well as for the adaptation of students to the dynamically changing labour market. This paper involves an empirical component to study and analyze the extent and manner of use of ICT by students in the learning process, to establish their motivation for improving the skills of digital literacy, in order to enable them not only to raise their academic results, but also to provide students the opportunity to be successful in society without lag behind the ever-changing demands of work and life.

Keywords

Information and communication technologies, education, digital literacy, university students, research

Article type

Full research paper

Article history

Received: June 17, 2014
Received in revised form: June 29, 2014
Accepted: July 8, 2014
Available on-line: July 31, 2014

Shopova T. (2014) "Digital Literacy of Students and Its Improvement at the University", *Journal on Efficiency and Responsibility in Education and Science, Vol. 7, No. 2*, pp. 26-32, online ISSN 1803-1617, printed ISSN 1803-1617, doi: 10.7160/eriesj.2014.070201.

Introduction

The paper is an extension of the article presented on the 11 th International Conference on Efficiency and Responsibility in Education (ERIE 2014) (Shopova, 2014a).

The development of information and communication technologies (ICTs) and their integration in all spheres of people's life and work gave for the first time a possibility for a fast and unlimited access to vast information which is constantly enriched, transformed and actualized. This new model of society needs citizens who possess the necessary skills and competences to take advantage of the potential of new technologies and take active part in the economic, social and cultural life.

Eco (1996) underlines that contrary to the McLuhan (1962), according to whom with the progress of electronic media the Gutenberg era coming to an end, the Internet not separates us and vice versa, made us to return to the Gutenberg. If the TV that directs us to the form of visual images leads to a decline of literacy, the computer anyhow implies working with verbal signs (reading words on the screen, data input, and communication in chat) restores the ability to work with printed texts. According to the Italian thinker, the computer has become an alphabetic instrument "on which one reads about the world in form of words and pages". In this way, the computer and the Internet return people back to the Gutenberg Galaxy because the consumers use written communication. Eco (1996) emphasizes an important feature of computer communication that is related with the intellectual effort of its users who are forced to continuously improve their literacy skills and acquire the ability to work with texts. The one-dimensional text is replaced by multi-dimensional electronic hypertext that directs us to the post Gutenberg era. Eco concludes that the work in this new era requires acquirement a new form of critical competence, a new kind of educational training.

The appearance of Web 2.0 increased the scale and dynamics of data collection and management which implies the use of the collective memory of the participants. It provided the users with the opportunity to take active part in the creation, sharing and combining a variety of content (text, events, photos, videos, artwork, etc.) and knowledge to expand their cooperation in a various websites. The free choice and quick access to all kinds of services and multimedia platforms outlined new ways to finding, storing and organizing large amounts of information. This laid the beginnings of a new "hyper-connected culture" characterized with a great variety, and an access to everything in different formats, with creation of dynamic collections where information is constantly updated (Dreyfus, 2010: 33).

The Internet and new media communication technologies with their interactive and increasingly individualized digital services change people's habits and behaviour, building new value models and vital cues. They are becoming an irreplaceable source of education and self-education and important tool for the development of new literacy. "No previous technology for literacy has been adopted by so many, in so many different places, in such a short period of time, with such profound consequences. No previous technology for literacy permits the immediate dissemination of even newer technologies of literacy to every person on the Internet by connecting it to a single link on a screen" (Coiro et al., 2008: 2-3). The Web is more than a simple information search and social contact feature,

it is also a learning tool that allows other ways to build and share knowledge (Loureiro and Bettencourt, 2014). In the digital era "the most fundamental change is not in the development of technologies as artifacts, but in their appropriation as tools and the power of these appropriations to change our thinking" (Huvila, 2012: 35).

An important priority of the Europe 2020 strategy of the European Commission (2010) is the development of new digital and media literacy skills for learning, creating, participating, and discerning use of digital media in order to meet the challenge of the global competitiveness. The educational systems were faced with the urgent necessity to provide new education programs corresponding to the needs of developing skills and abilities for effective use and understanding of digital technology as a basis for a lifelong learning.

The integration of many applications of ICTs, including different software systems and technology tools into the educational process and their successful use changes the content, methods and forms of training. The acquisition of skills and competencies in the digital age presupposes a new way of thinking and the ability of the user to continuously adapt to the new literacy required by the new technologies (Coiro et al., 2008).

Nowadays, ICTs have become a "key lever" for effective learning, and creative, innovative and responsible behavior in the new educational environment in the 21st century. Contemporary learning theory focuses on learning as an active process of constructing knowledge, which presupposes learning to be viewed as a personal understanding and meaning making (Oliver and Herrington, 2003). It is recognized that learners need to engage in cognitively complex tasks involving such activities as problem solving, critical thinking, collaboration and self-regulation. Chai and Lim (2011: 4) consist that from a pedagogical perspective ICT has made the construction of "knowledge" a viable approach of developing the creative ability of students. For learners it is very important not the transmission of facts and knowledge but formulating and acquiring significant skills and abilities to make research, select information sources and build their own knowledge so they can be always updated giving an adequate answer to the labour market (Goulão and Fombona, 2012: 351).

Introducing the concept of digital literacy

This part of the study draws inspiration from (Shopova, 2013) and (Shopova, 2014b).

Digital competence is determined by the European Union as one of the eight key competences for lifelong learning, which due to its versatility allows it to acquire other key skills (eg, mathematics, learning how to learn, creativity) and ensures active participation in society and economy (European Parliament and the Council, 2006: 15). This competence involves „the confident and critical use of Information Society Technology (IST) for work, leisure and communication".

The term digital literacy was introduced in 1997 by Paul Gilster in his book Digital Literacy where the author offers its definition focussing on the ability to understand, appreciate and use the information in multiple formats that the computer can deliver. Gilster (1997) insists that one should not consider digital literacy simply as "a book about how to get around the Internet". Moreover, the ability to evaluate and interpret the information is an essential. What matters is that through digital literacy one acquires basic thinking skills and core competences without which he could not orientate and perform tasks in an interactive environment.

The Gilster's concept was also used by other authors seeking to provide a more accurate understanding of digital literacy which includes a combination of different kinds of literacy based on computer/information competences focused on the skills to evaluate information and gather knowledge together with a set of understanding and attitudes (Bawden, 2008). The term digital literacy was extended and now it includes all sets of specific skills and competences needed for searching for, finding, evaluating and handling information in computerized form. Bawden (2008) sees digital literacy as a "framework for integrating various other illiteracies and skill-sets, though it does not need to encompass them all".

In determining the concept of digital literacy, some authors tend to understand it as a connection with the skills and competencies needed for effective use of the Internet and digital technologies (Martin, 2005; Cartelli, 2010; Ala-Mutka, 2011, etc.). Martin (2005) consists that digital literacy involves the convergence of several types of literacy: IT literacy, information literacy, technological literacy, media literacy, and visual literacy acquired new or increasingly important with the advent of digital environments. Each of the authors who adhere to a similar perception has gone from focusing on specific skills to the realization that the literacy is more integrative quality linked with the deployment of skills and competencies in the context of tasks or problems of real life (Martin, 2005). Due to the development of a range needed skills, the learner can understand the scope of information channels and resources to gain confidence for the accuracy, reliability and the precision of the obtained information to have more control over their own learning.

In recent years, studies of digital literacy accentuate the need of getting beyond the basic skills of using the information and digital literacy tools and resources and developing strategies for a critical and efficient use of these means. That's why most researchers view this literacy as "continuum, with progressive stages where the basic abilities are only the first step. The upper end of the continuum contains increasing levels of cognitive competence in using the literacy in question for tasks, learning, creating and expressing new ideas, and this involves issues such as attitudes and social and cultural aspects" (Ala-Mutka, 2011: 17).

In defining the framework of digital competence (Ferrari, 2012) it came to the belief that it is not sufficient to be claimed that digital literacy includes all the skills and competencies required for Internet literacy, ICT literacy, information literacy and media literacy. There are other components that come into the picture of digital literacy and build a framework that identifies the vision of new literacy needed for living, working and citizenship in the 21st century. Ferrari (2012) presents a comprehensive definition of digital literacy, which is built on different areas of learning - knowledge, attitudes and skills required to identify, locate, access, retrieve, store and organize the information. The focus here is primarily on solving problems, building new knowledge through technology and media in a critical, creative, flexible, ethical manner.

In their research Janssen et al (2013) expand this definition to identify twelve digital competence areas, among which may be indicated: General knowledge and functional skills; Use in everyday life; Specialized and advanced competence for work and creative expression; Technology mediated communication and collaboration; Information processing and management; Privacy and security; Legal and ethical aspects; Balanced attitude towards technology; Understanding and

awareness of role of ICT in society; Learning about and with digital technologies; Informed decisions on appropriate digital technologies; Seamless use demonstrating self efficacy. The experts conclude that digital competence is a conglomerate of knowledge, skills, and attitudes connected to various purposes (communication, creative expression, information management, personal development, etc.), domains (daily life, work, privacy & security, legal aspects), and levels (Janssen et al, 2013: 480).

In the present study, we will be based on this broader definition of digital literacy to direct attention to the role of digital literacy skills of students to use new technologies, which will have increasingly importance in the development of university education. The paper presents the empirical results of a survey performed in September 2013 at the SWU among first- and second- year students in humanities. The aim of the survey is to understand: a) How university students use information technology in the course of their training, b) What is the level of digital literacy of students in humanities, c) What is the motivation of students to enhance their digital literacy skills and competences, d) What are the ways and means of improving the level of digital literacy of university students (especially from first and second courses). It was important to establish the attitude of students towards the use of digital technologies for effective searching for, finding, critical evaluation and presentation of information obtained from various sources for educational purposes. We want to show the role of South-West University in Bulgaria in the process of encouraging and development of information-communication skills of students as a response to the European priorities in the area of digital technologies and future education.

Materials and Methods

This part of the study draws significant inspiration from (Shopova, 2014).

The task that placed in front of today's students is related with mastering the concepts, theories and basic knowledge of different disciplines and with understanding of all the necessary criteria and strategies to find relevant information that is valid for their area of study or research (Area, 2010). For university students it is necessary to have knowledge and skills in the field of digital technology to be able to use information effectively in its different forms (e-publications, online video, audio recordings, digital libraries, databases, etc.). Furthermore, students need to be able to work critically with the information resources that they find for the purposes of their learning activity and have the competencies to handle independently in resolving scientific issues in projects, studies, etc.

Therefore, a team from the Center for New Media and Digital Culture at SWU "N. Rilski" conducted a survey among 60 first- and second-year students who were divided unevenly as far as gender: 20 men and 40 women took part from the Department of Cultural Studies at the Faculty of Arts and the Department of Philosophy and Political Science at the Faculty of Philosophy of the University. The team members has suggested that first- and second-year students have serious problems in the learning process and need more support from lecturers and librarians to effectively use the Internet and information technologies as well as to seamlessly overcome the difficulties encountered by students in finding and using information needed to be successful in their course works.

The study was conducted through the method of direct personal inquiry through pre-designed questionnaire. It was based on the developed by the Association of University and Scientific Libraries standards and guidelines to improve information and digital competences in higher education (American Library Association, 2000), but also on the proposed by the Stanford University modules for assessing of information literacy among students. The questionnaire consisted of five set of questions.

The first set of questions was related to computer literacy of students to their ability to: Work with computers to access to information; Use computer tools for word processing; Create and form documents; generate tables, pictures and images; Use Microsoft Excel, databases, etc; Create graphs and charts, create presentations and slideshows, etc.

The second set of questions was to understand the students' access to the Internet and the skills to use the Web and to participate in the Internet environment. Students had to answer the following questions: What is their daily access to the Internet? How they use different tools and online resources to search for, find and retrieve information? Do they understand the basic concepts of the Internet including security issues? Do they use search tools for finding and retrieving information? Do they use e-mail and work with attachments?

The third set of questions was related to the establishment the ability of students to search independently and find effectively the relevant information and information resources for specific tasks; knowing and using library information resources in the network; using appropriate search strategies in different information systems (e.g. Google ™, Yahoo ™, Yandex and other resources for finding information), etc.

The fourth set of questions concerned the students` skills for critical and reflexive attitude towards information and responsible use of information technology as a prerequisite for social adaptation and work in the digital society. It presented such students' competences as: evaluating, analyzing, synthesizing, using and interpreting information, deriving new knowledge from acquired information and understanding the economic, legal and social issues related to the ethical and legal use of information.

The fifth set of questions aimed to show the motivation of students to improve their skills and competencies for using the Internet and digital technologies. Therefore, respondents were asked to answer the following questions: Do you think that your digital skills in the learning process are enough? Would you like to participate in training courses to increase your digital literacy? In what forms of training you prefer to be included in order to acquire skills for using ICT?

Results and Discussion

This part of the study draws significant inspiration from (Shopova, 2014).

1. The study showed that the majority of respondents positively evaluated their ability to work with computers to access information, as 76% of them indicated that these skills were good, 14% - very good and 10% - excellent. They used computer tools for word processing (40% said that their skills were good, 46% - very good and 14% - excellent). They were able to create and format documents, to generate tables, pictures and images (76% assessed these skills as good, 14% - very good and 4% - excellent). As for the ability to create presentations and present a slide show, 70% of students admitted they can make this well, 12% - very well and 18% - excellent (Table 1).

Ability of students to work with computer / ICT	Excellent	Very Good	Good
Using the operating system to access the information	96%	3%	1%
Working with computers to access the information	10%	14%	76%
Word processing	14%	46%	40%
Using the Microsoft Excel,databases, etc.	12%	30%	58%
Creating and formatting documents, tables, pictures and images	4%	14%	76%
Creating presentations and slideshow presentation	18%	12%	70%

Table 1: Computer /ICT skills of students

2. The survey data indicated that the majority of students used the Web and had daily access to the Internet (96%), 72% of which - mainly at home and 24% - at the university. They successfully used the Internet and information technology in the learning process having in mind that the easy and fast access to the needed information is facilitated them in their learning activities allowing them to respond to a considerable degree to the requirements for active participation and improve their academic results. Most of respondents indicated they used without difficulty some search tools to find and retrieve information (98%). They were able to: identify search results (78), know how to use e-mail (98%), create and send emails, and work with attachments (91%). Those who understood the basic Internet concepts, including security issues, however, were only 2%, and a significant portion answered "partially" (66%) or "no" (32%). Those students who could though rarely create their own web pages were only 7% (Table 2).

	Every day	At home	At the university
Internet Access	96%	72%	24%
Basic Internet Skills	Yes	Partly	No
Using the WWW	96%	4%	-
Using search tools to find and retrieve information	98%	2%	-
Identifying the search results	78%	15%	2%
Using E-mail	98%	2%	-
Creating and sending emails, and working with attachments	91%	9%	-
Understanding the basic Internet concepts	2%	66%	32%
Creating own web pages with text, images, and hyperlinks	-	7%	93%

Table 2: Internet access and basic students` internet skills

3. As for information literacy of students, data showed that 44% of respondents did not have effective and efficient access to information, and were satisfied with the information retrieval. More than half of the respondents recognized that they were partially satisfied by the searching for information. Half of the students said they could identify the key concepts and terms that describe the information need. 68% did not have difficulties when they have to determine different types and formats of potential sources of information (e.g. multimedia, databases, audio /video, book). Moreover, the majority of them (90%) did not have skills to distinguish the most important characteristics of the separate library information resources on the Web. 88% of respondents could not identify types of resources in the catalogue of the electronic university library to retrieve information (Table 3).

Abilities for seeking and retrieving information	Yes	Partly	No
Effective and efficient access to information	44%	56%	-
Satisfaction with information search	44%	56%	-
Identification of key concepts and terms that describe the information need	50%	50%	-
Determination of different types and formats of potential sources of information (eg, multimedia, databases, audio / video, book)	68%	32%	-
Construction of strategies for locating information	48%	52%	-
Differentiation of the major characteristics of separate library information resources on the web	-	10%	90%
Identifying types of resources in the catalogue of the electronic university library	2%	10%	88%
	Google	Yahoo	Others
Using Search Engines to find information	83%	7%	10%

Table 3: Students` ability for seeking and retrieving information

The survey indicated that students who could construct appropriate strategies for locating information in diverse information systems using different interfaces and search engines were 48%. 83% of respondents preferred Google over other search engines for finding information. Most students (82%) recognized they rarely used print media (books, newspapers, magazines, etc.) to assist the learning activities and relied heavily on the electronic media (44%). Few were those who regularly used online video (15%), online photo galleries (10%), electronic audio records (12%), virtual museums (8%) and digital libraries (5%) (Table 4).

What resources do you prefer to use?	Regularly	Sometimes	Rarely
Print media - newspapers, magazines, books, encyclopaedias, etc.	6%	12%	82%
E-media - newspapers, magazines, books, encyclopaedias, etc.	44%	23%	33%
Online video	15%	20%	65%
Electronic audio records	12%	10%	78%
Online photo galleries	10%	7%	83%
Virtual museums	8%	5%	87%
Digital libraries	5%	5%	90%

Table 4: Use of information resources by students

4. The next set of questions was related to the skills of students for critical and reflexive attitude towards information and responsible use of new technology. The study revealed that most students were able to analyze and synthesize information (71%), to compare information obtained from different sources (73%), and to know how to interpret and present information (52%). Fewer were those who had no skills to critically evaluate information and sources (45%) and had difficulties when they have to critically evaluate print and online resources based on specific criteria (72%), verify the authenticity and reliability of the data collected (64%). Although the majority of respondents (75%) said they were aware of copyright, many of them (25%) only occasionally followed laws, regulations and tags associated with the access to and use of the information resources, while 38% did not do this. (Table 5)

Skills for effective use of information	Yes	Partly	No
Analyzing and synthesizing information	71%	18%	11%
Comparing the information obtained from different sources	73%	20%	7%
Interpretation and presentation of information	52%	35%	13%
Critical evaluation of information and sources	45%	38%	17%
Critical evaluation of print and online resources based on specific criteria	28%	52%	20%
Verification of the authenticity and reliability of the data collected	46%	54%	10%
Understanding of what is the copyright and its ethically use	75%	16%	9%
Following laws, regulations, etiquette related to the access and use of the information resources	25%	35%	40%

Table 5: Students` skills for effective use of information

5. The last group of questions aimed to provide the motivation of students to develop their skills and competencies for using the Internet and digital technologies. The study found that 56% of the respondents were willing to participate in specific training courses that would give them greater opportunities to increase their digital competence. To the question what types of training they prefer, 68% of respondents answered that these were courses included in the curriculum of the specialty, while 12% of them said they could participate in specialized courses outside the specialty curriculum (in paid form of learning). There were also students (44%) who did not wish to participate in any training courses, lectures, seminars, etc. (Table 6)

Motivation of students	Yes	No
Would you like to participate in training courses?	56%	44%
Would you like to be involved in courses included in the curriculum of the specialty?	68%	32%
Would you like to be involved in specialized courses outside the specialty curriculum?	12%	88%

Table 6: Motivation of students to improve their digital competence

To sum up, we can say that the average score, which put 66% of the respondents on their computer literacy is "good" and only 17% of them indicate "very good". 42% say they have difficulties using the Internet for various activities, including helping their learning process. Students recognize that the information they obtain is insufficient to enable them to be valued more highly by lecturers. Average 56% of the respondents mark they experience difficulties when they have to search for and find information effectively and use specific information resources as the most preferred are e-publications (44%).

The study finds that the majority of students have no skills needed to take advantage of the electronic library at the university and do not know how to use its rich information recourses. Average 48% of the respondents recognize they have difficulty for critical and creative attitude towards information and its usage in an ethical and responsible manner. Many students do not know how to interpret the reference to a paper or journal, how to search databases effectively, or to assess the quality of different websites. Students typically rely heavily on one search engine to find information on the Web. Along with this, many of them copy information directly from websites without citing and have no awareness on the ethical issues related to the copying and citing when they use various sources to prepare their essays or course works. Irrespective of insufficient proficiency in the skills many students are not motivated to participate more actively in organized courses at the University.

The researchers note that the access to computers and the Internet, the ability to use word processing tools, to create and send emails, and work with attachments, to use operating system to access the information is no guarantee of competence of students and so are to be made more efforts to achieve higher levels of learning, connected with acquisition of competences to effectively solve problems and tasks. Students need to learn how to utilize those incredibly diverse and powerful technologies efficiently and effectively to search for, retrieve, organize, analyze, evaluate information and then to use it for specific decision-making and problem-solving ends (Horton, 2008: 5-6). In order to enable students to adapt to the challenges of the digital society and new practices for electronic learning environment is required to identify effective ways to invite, encourage and motivate towards the utilization of high quality theoretical and applied knowledge and skills for working. It is especially important to intensify the research activities of students by involving them in problem research groups and research projects. In this regard, Wolf (2007:10) underlines: "Open-ended tasks that are project -and research-based and require interpretation increase opportunities for students to increase motivation and engagement in specific subject areas".

Mastering digital information, the abilities to find, understand, evaluate and use information effectively and ethically in order to meet their personal and academic needs is fundamental to the learning process of students. Pérez and Torelló (2012: 1116) consist that ICTs have to understand "as symbolic and cultural technological systems needed to create, manage, analyze, communicate and transform information into new relevant knowledge". According to the authors this opens an opportunity for the person-the professional to be the one who properly uses and integrates ICTs, not only into its teaching functions, but into the rest of its professional roles, according to the best of its knowledge and professional experience.

The survey indicates some learning gaps to effectively use the Internet and ICTs by first- and second-year students in humanities. This suggests that it`s necessary lecturers to increase efforts to raise awareness of the nature and importance of digital literacy in education. The study highlights an understanding among researchers that digital literacy must be considered as a situated practice, and that it concerns functional and communicative competencies rather than acquiring a set of technical skills (Knutsson, Blåsjö and Hållsten, 2012). It is outlined the significance of acquiring key skills for seeking, finding and managing information, for critical and efficient use of digital tools and information recourses, and creation of new knowledge. For experts and scholars the old pedagogy delivered with new technology does not work. The advancement in information and communication technology has a significant impact on the way teachers teach and the way students learn, and for technology to result in quality learning (Pérez and Torelló, 2012).

It is highlighted the importance of acquisition of competences in relation to communication in the virtual space, as well as the ethical and social challenges that arise in this context, the skills needed to search for information and management, to participate in different networks, etc. (Henriksen, 2011). So Henriksen (2011) suggests considering the issue of effective use of the opportunities for technology-mediated learning, on the one hand, and the processes of digitally based learning within and outside educational institutions, on the other.

The survey results show on which specific skills the university and lecturers should pay more attention to ensure a more effective inclusion of students in education what is important for the adaptation of students to the challenges of the digital society and new learning practices. The efforts of the university suggest also the more active involvement of students in various courses, and mastering skills for a more effective approach to finding and using information that suggests its critical analysis and evaluation, creative use of different sources to solve problems and manage information in a responsible manner. From this perspective, especially suitable are the courses included in the curriculum that will provide the skills needed for using digital technologies. For example, we can offer such courses as "Basic Computer/ICT Skills", "Digital Literacy Skills", "Academic Writing", etc. whose purpose will be to improve the student´s knowledge and skills, meaningful and practical adequate the requirements of modern education. The realized courseware will allow unfolding more active work in the direction of integration of digital literacy in the learning environment focusing on certain important aspects of development of students' digital competences. It's important the role of library professionals who can offer information literacy services through self-directed learning and "cooperation with lecturers, so that the latter can incorporate content into their teaching-learning activities that contributes to students' information competency" (Gomez Hernandez, 2010: 45). Library staff must endeavor to offer programs for digital literacy, including skills training for use of the library and its information educational resources. Denchev and Pavlova (2009: 57) indicate the primary objectives of the e- library "to support learning in the processing of digitized information, encourage and motivate its use, to convince students of the benefits of digital resources without ignore the traditional media (learning relies on various electronic databases format containing the most diverse information)". Involving students in additional short-term or long-term courses (with paid form of learning) may also contribute to the acquisition of important knowledge and skills for that are not given enough places in the curricula.

Undoubtedly, the efforts to increase digital literacy of university students should begin in primary and secondary school to provide basic computer and information literacy competences or "cognitive and operational skills and attitudes necessary for the effective use of information and communication technologies" (Rambousek, V. et al., 2013: 246). Should not be underestimated and the conduct of seminars and lectures, the ability to access online tutorials, e-books and other forms of enhancing student´s digital literacy, through which we can expect the development of a wide range of skills for searching, identification, critical evaluation and use of information for a more independent and creative behavior in the digital environment.

Conclusion

In the European Union initiative called "e-Learning" (2000) clearly was identified the need to increase the key competences and later in the adopted Communication on "e-Skills for the 21st Century", EU indicated the importance to consider the problem of digital (not) literacy (Commission of the European Communities, 2007). In the new educational environment with integration of ICT into subject teaching the learning of students gets a new dimension. For more flexible adaptation to a lifelong learning, the role of digital competence is increasing. Its construction requires confident and critical use of information technology for learning, working and communicating. Students need to "learning to learn", which involves increased control over the process of one's own thinking and education which means an "ability to pursue and persist in learning, to organize one's own learning, including through effective management of time and information, both individually and in groups" (European Parliament and the Council, 2006). By acquiring fundamental skills as literacy and competences in the area of digital technologies, one should be able to easily access information, to acquire, analyze and integrate new knowledge and skills, as well as to have "the ability to persevere with learning, to concentrate for extended periods and to reflect critically on the purposes and aims of learning".

Our study shows that improving digital literacy of students and their skills in using ICTs is an important condition for the successful performance and achieving better results in the learning process. Acquiring required digital literacy competencies is a prerequisite for expanding access to information and communication technologies in order to ensure greater competitiveness of young people on the labor market.

The majority of young people, who come to the university, do not have skills needed for using the Internet and information technology, when they have to solve scientific problems, to perform different tasks individually or in a teams. They are good at using social networking, e-mails or skype, surfing the internet, showing as active gamers and participants in virtual communities, but their knowledge and competences for effective use of new technology in the learning process are often superficial. And here it's important the role of the South-West University to adopt a comprehensive strategy, which can speed up the process of motivating and supporting students in the direction of development, improvement and enhancement of their skills through effective use of the vast potential of digital technologies. The achievement of greater efficiency of the learning process in the university environment requires the acquisition of skills by students to search for and find useful information and resources, but also the ability to analyze and synthesize received information, share and discuss different ideas and perspectives that can support students to solve problems in teams.

The study team considers that the data obtained from the research can be used: 1. As a basis for further research on digital literacy among students of the South-West University; 2. As the basis of research of digital competence of students in Bulgaria; 3. For comparison with data from future research in this area in the university; 4. In the processes of identifying needs and interests of Bulgarian university students to improve their digital literacy; 5. In the process of motivating students to develop their digital literacy skills and competences for working and creative expression in the new learning environment.

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COMPUTER SELF-EFFICACY OF PROSPECTIVE PHYSICAL EDUCATION TEACHERS

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Highlights

- *Physical education and Sport*
- *Educational Technology*
- *Computer Self-Efficacy*

Abstract

This study investigated the computer self-efficacy of Turkish prospective physical education teachers. The research group consisted of 173 prospective physical education teachers. In the study "Computer Self-Efficacy Perception Scale" was used as data collection tool. Results indicated that prospective physical education teachers obtained high computer self-efficacy scores. Prospective physical education teachers' computer self-efficacy was also examined according to their gender and class year no significant difference was found. In the study it has also found that no significant correlation between prospective physical education teachers' computer self-efficacies and their ages. In addition there was significant difference in the scale of computer self-efficacy perception based on the owner of a computer.

Keywords

Technology, university student, physical education and sport

Article type

Full research paper

Article history

Received: June 4, 2014
Received in revised form: June 18, 2014
Accepted: July 7, 2014
Available on-line: July 31, 2014

Huseyin, U. and Suel, E. (2014) "Computer Self-Efficacy of Prospective Physical Education Teachers", *Journal on Efficiency and Responsibility in Education and Science, Vol. 7, No. 2*, pp. 33-36, online ISSN 1803-1617, printed ISSN 1803-1617, doi: 10.7160/eriesj.2014.070202.

Introduction

Technology has made a remarkable impact on society, especially in the education arena. The teaching and learning process has recently been altered by the convergence of a variety of technological, instructional, and pedagogical developments (Bonk and King, 1998). One of these technological tools is computers. Computers are common tools in most schools, and are being used increasingly in all subject areas (Khorrami-Arani, 2001).

Being common tools in most schools, computers are used increasingly in all subject areas. Especially in universities, teachers' expectations from students regarding their computer abilities have been increasing. Majority of teachers do not accept hand written projects; instead, they usually prefer presentations prepared on computers, and they also expect their students to do further studies, comparisons of their subject with different authors results (İşman and Çelikli, 2009). Although some students are enthusiastic about using computers, others may be more apprehensive. In so far as computers aid learning and are common tools in the workforce, it is crucial for all students to become familiar and comfortable with their use (Khorrami-Arani, 2001).

Among the various individual factors examined in past research, computer self-efficacy (CSE) has been identified as a key determinant of computer-related ability and use of computers (Hasan, 2003).

The continuous increase of efficacy and importance of computer and computer products in learning-teaching processes is also important for features of teachers, who will use these technologies. Computer self-efficacy of teachers who will use computer is very important for the use of this technology (Aşkar and Umay, 2001). Computer self-efficacy was also found to be associated with attitudes toward computer technologies (Zhang and Espinoza, 1998).

Computer self-efficacy is a specific type of self-efficacy. Compeau and Higgins (1995) defined computer self-efficacy as "a judgment of one's capability to use a computer" (p. 192). Studies showed that higher levels of computer self-efficacy corresponded to increased performance in computer courses and a greater achievement of computer competency (Khorrami-Arani, 2001).

Computer self-efficacy has been investigated in education contexts including university students especially who educated teacher education programs (Karsten and Roth, 1998; Aşkar and Umay, 2001; Akkoyunlu and Kurbanoğlu, 2003; Yusuf, 2005; Özçelik and Aşkım-Kurt, 2007; Kao and Tsai, 2009).

These studies generally focus on determining university students' and prospective teachers' belief on computer self-efficacy according to the variables. In addition, the relationship between attitudes toward and self-efficacy regarding the computer and/or the Internet has been examined in many previous studies. The studies in the field showed that individuals whose computer self-efficacy levels are higher are more desirous about and interested in using computer and they have higher expectations from kind of studies. In addition, when these individuals encounter difficulty in any of the computer; they can easily cope with it (Karsten and Roth, 1998; Akkoyunlu and Orhan, 2003).

Use of computer during the educational process will enable the process to be more effective and efficient. Computer usage levels and computer self-efficacy of physical education teachers, who are the executives of physical education lesson that is an inseparable and important part of the general education, are important, in terms of the process of teaching-learning. Use of

computer by physical education teachers is among important features to be possessed by physical education teachers, in line with the sense of the developing education. Computer self-efficacy of physical education teachers will bring along the desire and eagerness to use computer. Besides, the determination and development of computer self-efficacy of prospective physical education teachers is also important for physical education teachers to use computer and educational technologies in educational activities. This paper is extension of Ünlü and Suel (2012). The aim of this study is to determine the computer self-efficacy of prospective physical education teachers.

Methods

Research Model and Sample

The research was conducted using a descriptive research model for determining the prospective physical education teachers' computer self-efficacy. The research group was consisted of 173 prospective physical education teachers who were enrolled in various years (1- 4 class) of physical education and sports teaching programs at 3 universities during the 2010-2011 school year.

In terms of gender, 76 (43.9 %) of participants were female, and 120 (56.1 %) of whom were male. The ages of the students ranged between 18 and 31 years, and the average age was 21.96 ± 2.43 years. The grade level of participant, 26.6 % (n=46) of participants were freshman, 28.3% (n=49) were sophomore, 26.6% (n=46) were junior, and 18.5% (n=36) were in the senior. Also in the research group while 139 (% 80.3) prospective physical education teacher have the owner of a computer, 34 (%19.7) have not the owner.

Participants were drawn via purposive sampling. By considering the study's main purpose samples were chosen, "enrollment in physical education and sports teaching programs", via maximum variability method in the types of purposive sampling. This sampling method is give important clues about the values of population (Fraenkel & Wallen, 1993).

Instruments

In this study, two scales were used to collect data. In the first scale, which was developed by the researcher in order to define the demography of participants, gender and class year were included. The second scale is "Scale of Computer Self-Efficacy Perception". Scale of computer self-efficacy perception was developed by Aşkar and Umay (2001) and it involves 18 items which 7 of them were scored in the reserve direction in the scale.

Reliability coefficient of the scale is 0.71. Cronbach's alpha was calculated as 0,83 in the study. It is designed as a 5-point Likert scale with response categories of: always, usually, sometimes, rarely, and never. While the positive items of the 5-point likert scale are scored as "always 5 – never 1", negative items are scored inverse as "never 5 – always 1".

Data Analysis

Descriptive statistical techniques were used in the data analysis. At the same time when it was seen that the variances displayed a homogenous distribution, t–test was used for independent groups in order to determine the prospective physical education teachers' computer self-efficacy in terms of gender variable. In addition One-way Anova was used in the comparisons in terms of grade levels. The significance level was taken as 0.05 in the comparisons ($p< 0.05$).

Results

In this part of the research, presented findings related to prospective physical education teachers' computer self-efficacy and their efficacies a terms of gender, year of class and owner of a computer. Also it was presented correlation between prospective physical education teachers' computer self-efficacy and their ages.

Findings concerning standard deviation values and the mean values that prospective physical education teachers obtained in the whole of the scale of computer self-efficacy perception the study group (n=173) was found as $\overline{X}$ =3.24 (SS ± .285).

t - test (Independent Samples t test) was carried out in order to determine if there were any differences between prospective physical education teachers' computer self-efficacy in terms of the "gender" variable. The results are presented in Table 2.

Table 1. Comparison of prospective physical education teachers' computer self-efficacies in terms of the variable of gender.

Gender	N	$\overline{X}$	SD	T	df	p
Female	76	3.29	.285	2.078	171	.455
Male	97	3.20	.280			

As displayed in Table 1, which involves the comparison of computer self-efficacy of prospective physical education teachers in terms of the variable of gender, it was observed that while female prospective physical education teachers obtained an average of $\overline{X}$ = 3.29, male prospective physical education teachers obtained an average of $\overline{X}$ = 3.20. Accordingly, no significant difference was observed in the scale of computer self-efficacy perception based on gender.

One-way ANOVA was carried out in order to determine the prospective physical education teachers' computer self-efficacy in terms of the "year of class" variable. The results are presented in Table 3.

Table 2. Comparison of prospective physical education teachers' computer self-efficacies in terms of the variable of class year.

Class year	N	$\overline{X}$	SD	df	f	p
1. Freshman	46	3.18	.285	3	.883	.451
2. Sophomore	49	3.24	.248			
3. Junior	46	3.26	.311	169		
4. Senior	32	3.27	.302	172		
5. Total	173	3.24	.285			

The prospective physical education teachers' computer self-efficacy in terms of their years of classes were given in Table 2. It can be seen that the prospective physical education teachers had the highest mean at the senior class (4th) with $\overline{X}$ =3.27 and prospective physical education teachers who were freshman (1st) had the lowest mean. There were no significant differences observed in the comparisons according to the prospective physical education teachers' years of class.

t - test (Independent Samples t test) was carried out in order to determine if there were any differences between prospective physical education teachers' computer self-efficacy in terms of the "owner a computer" variable. The results are presented in Table 3.

Table 3. Comparison of prospective physical education teachers' computer self-efficacies in terms of the variable of owner a computer.

Owner a Computer	N	Mean	Sd	t	df	p
Owner	139	3.27	.278	2.831	171	.005
Non-owner	34	3.11	.285			

With reference to Table 3, prospective physical education teachers who owner a computer obtained an average of $\overline{X}$ = 3.27 and who have not the owner of a computer obtained an average of $\overline{X}$ =3.11. It was seen that there were significant difference in the scale of computer self-efficacy perception based on the owner of a computer.

Person Coefficient Correlation Test was carried out in order to determine if there were any correlation between prospective physical education teachers' computer self-efficacy and their ages. The results are presented in Table 4.

Table 4. Correlation of prospective physical education teachers' computer self-efficacies in terms of the variable of ages.

Computer Self-Efficacy and Age	Age	Total Mean
Pearson Correlation	1	-.101
Sig. (2-tailed)		.188
N	173	173

In Table 4, correlation between prospective physical education teachers' computer self-efficacies and their ages were presented. Accordingly, no significant correlation was observed between prospective physical education teachers' computer self-efficacies and their ages (r = -.101 p>0.05).

Discussion

Computer self-efficacy of prospective physical education teachers was examined in the study. It was observed that prospective physical education teachers obtained an average of $\overline{X}$ = 3.24 from the scale of computer self-efficacy beliefs. Accordingly, it could be argued that prospective physical education teacher's had the high computer self-efficacy.

Computer self-efficacy studies, which used student subjects at a university level, showed that higher levels of computer self-efficacy corresponded to increased performance in computer courses and a greater achievement of computer competency (Karsten and Roth, 1998; Langford and Reeves, 1998).

Studies demonstrated that computer self-efficacy has an impact on increasing the performance and the technological innovation of employees, reducing computer induced anxiety, and promoting higher occupational positions (Compeau and Higgins, 1995; Harrison and Rainer, 1997).

In the study another result that is obtained is related with the self-efficacy of prospective physical education teachers, in terms of the variable of gender. Accordingly, no significant difference was observed among computer self-efficacy of prospective physical education teachers, in terms of the variable of gender.

Research on computer self-efficacy also revealed that males on average have better computer self-efficacy than females in general (Brosnan and Lee, 1998; Işman and Çelikli, 2009; Torkzadeh and Koufteros, 1994). But in some other studies that were performed on university students; Adalıer (2012), Çağırgan-Gülten et al. (2011) and Sam, Othman and Nordin (2005) observed no significance difference among computer self-efficacy in terms of the variable of gender.

Another result that is obtained from the study is related with the computer self-efficacy of prospective physical education teachers, in terms of their class levels. Accordingly, no significant difference was found on the computer self-efficacies of prospective physical education teachers, in terms of the variable of class. A similar study result was encountered in the study, which was performed by Yılmaz et al (2006). Besides, in the study that was performed by Gerçek et al (2006) and had a significance level of 0.01, it was observed that there was no significant difference between the computer self-efficacies of prospective teachers. These results were observed to have supported the result obtained from the study. However, in the studies performed by Zehir-Topkaya (2010) and Akkoyunlu and Kurbanoğlu (2003), it was observed that the variable of class formed a significant difference. This result that was obtained from the study could generally be explained with the fact that prospective physical education teachers start using computer at an early age and use of computer becomes widespread.

In the comparisons made according to prospective physical education teachers' whether owner a computer, it was seen that prospective physical education teachers who had owner a computer had higher computer self-efficacy than the who did not owner a computer. In the study which was carried out by Özçelik and Aşkım-Kurt (2007) also found those primary school teachers who have the personal computer had higher self-efficacy. This result supports the findings obtained in the present research.

According to this result it can be argued that prospective physical education teachers who have the owner of the computer have the opportunity whenever they need this may be cause to their higher computer self-efficacy.

The latest result of the study was related correlation between prospective physical education teachers' computer self-efficacy and their ages. In the study it was not observed significant correlation prospective physical education teachers' computer self-efficacy and their ages. Akkoyunlu and Orhan (2003) in their studies was found that significant differences in the comparison of computer self-efficacy of students and their ages also stated that the increasing of the students' ages increasing of the computer self-efficacy. In another study Özçelik and Aşkım-Kurt (2007) argued that computer self-efficacy differentiate according to the age, and in their studies was stated that teacher who were the between 20-25 had the highest self-efficacy and teachers who were the 40-45 had the lowest computer self-efficacy. These studies were not consistent with present study.

According to this result, the were no relationship between computer self-efficacy and ages, the average age of the prospective physical education teacher had lowest and it can be thought that they have the similar experiences about the computer.

Conclusion

Self-efficacy is a subject that has significantly been emphasized in education especially in recent years. It is known that individuals with a high perception of self-efficacy trust their own skills more to achieve a goal and they have a greater faith to succeed. Common use of computers during the educational process will increase the performance in the process of teaching. From this aspect, computer self-efficacy of prospective physical education teachers will make positive contributions to the educational process during the physical education lesson. This study determined the computer self-efficacy perceptions of prospective physical education teachers. In the study it can be concluded that computer self-efficacy of prospective physical

education teachers was at a high level. While there were no significance differences according to the gender and class level between computer self-efficacy; it was found that significant differences owner a computer between computer self-efficacy. In addition any significant correlation was observed between prospective physical education teachers' computer self-efficacies and their ages.

Future studies will be carry out large population and use another variable such as computer experiences, giving course etc. Additionally, it might also discuss how to increase the computer self-efficacy of prospective physical education teachers.

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EFFICIENCY OF PRACTICING WITH MATERIALS USING ICT AND PAPER ONES IN MATHEMATICS

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Highlights

- *1. • The assessment of efficiency of practicing with materials with or without ICT*
- *2. • 74 % students chose Interactive computer Auto-Evaluation Test for practicing in mathematics*
- *3. • Average improvement in mathematics after practicing with was 40 %*

Abstract

The research examines the effectiveness of utilization of practicing materials using ICT and classical study support – printed material in teaching Mathematics. The research was held as a pedagogical experiment at the Faculty of Chemical Technology, University of Pardubice in academic year 2012-13. In the research group there were included 559 students in the full-time form of study, in their first semester of study. Students were subjected to pretest and posttest, between these tests they were encouraged to practice through a material on basic calculus of functions of one variable. The practicing material was prepared both in classical (paper) form, both with an application of ICT. We registered results in pretest and posttest (in points), used practicing materials, successfulness in exam and continuing in studies after the first semester. The experiment looks for statistic relations among these variables. We present part of these statistic results.

Further quantitative and qualitative evaluation of the project is planned to be a component of dissertation.

Article type

Full research paper

Article history

Received: April 30, 2014
Received in revised form: June 29, 2014
Accepted: July 2, 2014
Available on-line: July 31, 2014

Keywords

Auto – Evaluation Test (AET), Information and Communication Technologies (ICT), Pedagogical Experiment, Posttest, Practicing, Pretest

Widenská E. (2014) "Efficiency of Practicing with Materials Using ICT and Paper Ones in Mathematics", *Journal on Efficiency and Responsibility in Education and Science, Vol. 7, No. 2*, pp. 37-43, online ISSN 1803-1617, printed ISSN 1803-1617, doi: 10.7160/eriesj.2014.070203.

Introduction

Education in the Czech Republic faces a decline in mathematical literacy. In results of the PISA (Programme for International Student Assessment) in 2012, the Czech Republic results in changes in mathematical literacy in the country from 2003 to 2012 were in 34th level of 39 assessed countries (Palečková, J. 2012). In 2009, the Czech Republic results in changes in the country between 2003 and 2009 were even in last place from 40 evaluated countries (Palečková, J., Tomášek, V. and Basl, J.2009).

The findings in the preliminary research (Widenská, 2011) show that although university students tend to understand the math curriculum and regularly attend training at school, almost do not practice at home.

One of the opportunities which are offered to increase the attractiveness of domestic practice is the use of ICT. In a study from 2009 (Rideout, Foehr, and Roberts, 2010) we can see how huge amount of time young people spend on the computer and on other media. This time could become a great power if we knew how to grasp advantage of its potential.

The trend of our period becomes to help making mathematics more exciting, relevant and challenging to young learners (Oldknow, 2009).

Some students are majorly in nonmathematical fields, some feel some anxiety about math (Bennett and Briggs, 2004).

There is a challenge for us - how to approach the teaching of mathematics to students who have not been (or were only slightly) led to the logical and critical thinking, and are used to learn mathematic „rote" without a real understanding of the issues discussed (Friedrich, 2006).

These ideas, trends and reality of our "ICT age" led us to perform a pedagogical experiment:

To offer students practicing material which:

- Is connecting useful and enjoyable – because they like playing games on PC and doing different tests – they can learn at the same time, so it is possible to do auto-evaluation test (self-check test) about understanding specified subject of mathematics
- Will be available also in printed form for those who would prefer it, also as auto-evaluation test
- Will not stress with its complicated form – mostly students have much scholarly learning material, but they do not understand it
- Will be interesting and understandable even for those who "feel some anxiety about math"
- Will result with clear answers to essential subjects of specified topic to understand fundamental principles. The aim is mathematical literacy could grow: "Mathematical literacy is defined as: to know, understand and be able to use the appropriate grade curriculum, which is essential" (Hošpesová, 2011:27)
- Will cause a system in fundamental principles
- Will contain auto-evaluation test (self-check test)

The pedagogical experiment will search:

- Relation between taking part in an experiment and students´study results
- Efficiency of specified combinations of practicing materials in relation to study results and improving results between pretest and posttest

The objective of the paper:

- To determine the effect of practicing on study achievement of university students in mathematics
- The results of students using ICT are compared with the results of those who used either only classical learning support or both
- At the same time, it investigates the effectiveness of particular methods of practicing in various combinations with regard to results achieved in study

Related to these aims we defined these main working hypotheses:

H1: Taking part in the research (i.e. in pretest, practicing and posttest) has an impact to study results of involved students

H2: Practicing mathematics using ICT in teaching is more effective and improves understanding of the topic more than practicing with the study support in the classic form - on paper.

H3: Practicing math with the help of ICT improves more subjective feeling in certainty of answers in the tests and reduces more both tests difficulty rating than with practicing with the study support in the classic form – on paper.

Abbreviations used in this paper can be found in Table 1.

Materials and Methods

Previous research

Preliminary research

Preliminary research was carried out in the academic year 2010-11 (Widenská, 2011) at the Faculty of Chemical Technology, University of Pardubice. Unsatisfactory level of students admitted to study in basic mathematical knowledge and skills has been proven.

Also there was shown large knowledge distance among students coming from different types of schools.

Despite the relatively large effort to regular attendance and understanding of the curriculum during seminars taught math, students were practicing at home very little.

Based on these findings there were formulated the following research questions:

Will be increased understanding mathematics through applications of auto – evaluation test (AET)?

Will be the effectiveness of using the interactive computer AET (PC AET) higher than practicing with AET in printed form?

Will we be successful in motivation of students to practice the tested subject after the preliminary research showed that a large part of the seminar participants almost didn´t practice at home?

A pilot study

A pilot study with 620 included students in the full-time form of study, in their first semester, was realized in academic year 2011-12. Its results were published: (Widenská a), 2012), (Widenská b), 2012), (Widenská c), 2012).

Due to the results and commentaries in *ICTE conference, Ph.D. students' section,* there were made several revisions and changes the research to be continued in academic year 2012-13.

Plan of research

Time limitation

The research took place in the winter semester of 2012 -13 and in the subsequent examination period.

Students met the first information about the ongoing research in the eighth week of the semester. In the tenth week of the semester the students were subjected to a pretest. In the same week, just after the pretest, the students received practicing materials and in the twelfth week were subjected to a posttest. Both tests were conceived in relation to practicing material.

During the examination period, students were tested in writing, they had to solve several problems in the selected subjects of the entire semester, some of tasks here were chosen with regard to the AET. The last day of testing was 28th May 2013.

Data Collection

Students who took part in the research filled in the pretest and the posttest. Each test was rated from 0 to 20 points.

There were recorded each student's:

- pretest results (IN)
- posttest results (OUT)
- kind of used practicing material
- subjective feeling in certainty of answers in the tests
- both tests difficulty rating
- results of the exam (EXAM)
- information about continuing in study after the first semester (CONT)

Information about subjective feeling in certainty of answers in the tests and both tests difficulty rating connected with working hypothesis *H3* will be statistically processed in the dissertation.

Concepts

The practicing material included two kinds of topics:

- refreshing and summarizing some of the basic knowledge acquired during high school, necessary for understanding the principle of differentiation of functions of one variable
- for most students new topic Fundamentals of differential calculus of functions of one variable (further mentioned as a derivative)

Practicing materials were intended to lead illustratively and schematically the student to repeat, respectively understand the concepts and relations among them. This is not only a formal knowledge of definitions, but their active application in examples, where it is recognized understanding of the topic.

The course of the experiment

Information for students

The students met the first information about ongoing research in the eighth week of the winter semester 2012-13 during lectures in all study groups. The information contained schedule, explanation, conditions and benefits to students for participation in the research.

Students were motivated to practice math as follow:

- They had opportunity to get up to 20 points for the output test (posttest). These points will be added to the exam test (there is a maximum of 100 points); entire posttest contained part of the topics discussed in the course Mathematics 1.
- They could check answering in the AET questions of a similar type like in an exam.

The tasks for the students were:

- To take part in the entrance test (pretest) in the 10th week of the semester. This pretest did not generate any point advantage for students, but its completion was a condition for participation in the output test.
- To practice using the practicising materials accessible after passing the pretest. Students had minimally 12 days for practicing.
- To take part in the output test (posttest) in 12th week. The results of this test had been announced to students before the start of their exam period.

Entrance test (pretest)

Pretest was assigned to show the input level of specified knowledge.

In its first half it contained repeated basic concepts (10 questions for 10 points), in its second half it contained topic derivative (10 questions for 10 points).

Both the pretest and the posttest were designed to verify understanding the topic - all of the key knowledge and skills listed in practicing material were chosen for them.

Pretests were used for later comparison with the results of the posttest.

377 students participated in the pretest.

Practicing

In addition to lectures and seminars (ongoing for the topic till 9th week of the semester) students received practicing material with its content targeted directly to the theme of the posttest.

The content of practicing material was determined both considering the results of the pretest in previous research in 2011-2012 and considering the newly acquired knowledge and skills base showing understanding of calculus.

Types of practicing materials: the theme was prepared in these types:

- Summary (S) - summarizing survey part - repetition and explanation
- Auto-evaluation tests (AET). AET aimed to verify understanding of the matter in the form of answers to questions (as in the examination test), but there were given the correct answers.

AET had two forms, both were with the same tasks. Students chose responses (multiple-choice), answered open questions with extensive or brief answers.

- "Paper" (PA) AET could be either printed on paper or worked with by watching on a computer monitor in a form of presentation. It was not interactive; for checking the correct answers there were results at the end of the test. The sequence of questions was logically arranged from the easiest task to the most difficult one.
- In "Interactive computer" (PC) AET it was necessary to click the correct answer (1 task = screen). Another question was provided to the student after marking the correct answer; in the case of wrong answer it could be marked again.

  PC AET was made both in sequential version - still the same, logically arranged sequence of questions as in paper form; and random version - different order of questions generated by a computer. The advantage of the sequential test is gradually increasing demands on the understanding and application of concepts, the disadvantage is the possibility of remembering the order of answers in the test. This disadvantage is eliminated in the test with random sequence of questions, but it is more suited for students who passed successfully through the sequential version of the test.

  PC AET was created in the author system Macromedia Authorware – the University owns its licence. Macromedia Authorware is one of the most comprehensive authoring tools for creating e-learning applications, popularly educational e-books, interactive training courses. Environmental control program is simple and intuitive. It is possible to import a PowerPoint presentation into it.

  The students in the research obtained .exe files with PC AET so they were able to work with no special software on their computers.

Students had the opportunity to choose any method or combination of practicing. They mentioned used methods in the questionnaire at the end of the posttest.

Because we expected students to use also different type of practicing material for preparation to the posttest (such as notes from their high school), in the questionnaire there was possibility to mark "another practicing material".

Output test (posttest)

Posttest showed advance of students in specified skills after practicing.

The concept of the posttest was the same as the pretest, only numeric values were different.

Posttest was attended by 343 students.

Results

Abbreviation	Meaning
AET	Auto-Evaluation Test
ALL	Amount of students who used all given practicing materials
CONT	Amount of students who continued in studying after 1 semester
CONT%	Amount of students who continued in studying after 1 semester in percents
EXAM	Amount of students who passed the exam
EXAM%	Amount of students who passed the exam in percents
IN	Amount of points received in pretest (IN-test)
NONE	Amount of students who used no given practicing materials
nonCONT	Amount of students who did not continue in studying after 1 semester
nonEXAM	Amount of students who did not pass the exam
OUT	Amount of points received in posttest (OUT-test)
PA	Amount of students who used practicing material: just Paper AET
PA AET	Practicing material: Paper AET
PA+	Amount of students who used practicing material: Paper AET
PAPC	Amount of students who used practicing material: just Paper AET and Interactive Computer AET
PAPC+	Amount of students who used practicing material: Paper AET and Interactive Computer AET
PC	Amount of students who used practicing material: just interactive computer AET
PC AET	Practicing material: Interactive Computer AET
PC+	Amount of students who used practicing material: Interactive Computer AET

Abbreviation	Meaning
PM	Practicing material
REG	Amount of all students registered in subject of Mathematics 1
S	Amount of students who used practicing material: just Summary
S+	Amount of students who used practicing material: Summary
SPA	Amount of students who used practicing material: just Summary and Paper AET
SPA+	Amount of students who used practicing material: Summary and Paper AET
SPC	Amount of students who used practicing material: just Summary and Interactive Computer AET
SPC+	Amount of students who used practicing material: Summary and Interactive Computer AET
Summary	Practicing material: summarizing survey part - repetition and explanation
Used	Amount of students who used specified practicing material
Used %	Amount of students who used specified practicing material as percentage of total
WGroup	Amount of students in specific whole group
WGroup %	Amount of students in specific whole group as percentage of total
Wrote IN	Amount of students who wrote only pretest (IN-test)
Wrote IN+	Amount of students who wrote pretest (IN-test)
Wrote IN+OUT	Amount of students who wrote pretest (IN-test) and posttest (OUT-test)
Wrote NONE	Amount of students who wrote neither pretest (IN-test), nor posttest (OUT-test)
χ^2	Chi-square test of independence

Table 1: Abbreviations

Group	REG	Wrote NONE	Wrote IN	Wrote IN+OUT
WGroup	559	182	34	343
EXAM	310	15	10	285
CONT	338	31	14	293

Table 2: Amounts of students in different phases of the pedagogical experiment

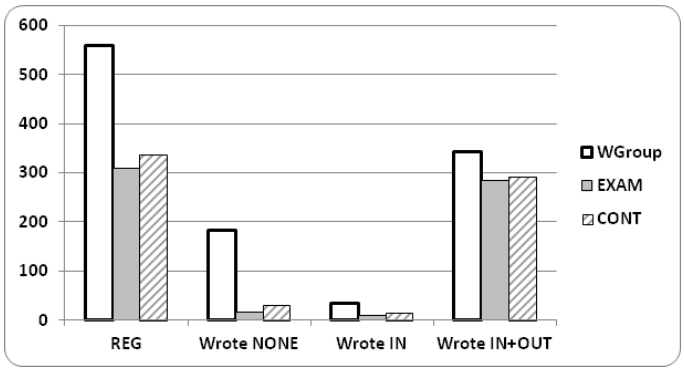

Figure 1: Graph of amounts of students in different phases of the pedagogical experiment

Group	REG	Wrote NONE	Wrote IN	Wrote IN+OUT
WGroup %	100	100	100	100
EXAM %	55	8	29	83
CONT %	60	17	41	85

Table 3: Amounts of students in different phases of the pedagogical experiment in percent of each group

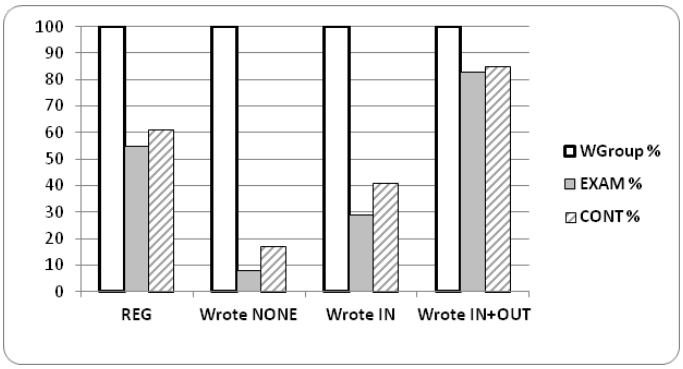

Figure 2: Graph of amounts of students in different phases of the pedagogical experiment in percent of each group

Taking part in the experiment

Table 2 with Figure 1 shows amounts of students who took part in specified phases of the experiment, Table 3 and Figure 2 shows the same in percent of each group.

At the beginning of winter semester 2012-13 there were registered 559 (the group "REG") students in the subject of Mathematics 1.

343 students (61 % from the group "REG") participated in posttest. This number highly overcame our expectation. In the pilot study 2011-12 306 students from 620 passed through the whole experiment, that was 49 %. That means in 2012-13 we had 37 students in the group "Wrote IN+OUT" more than a year ago.

310 (55 %) of the group "REG" successfully passed the exam and 338 (60 %) continued in their studies after the first semester.

182 students did not write any test, 15 (8 %) of them successfully passed the exam and 31 (17 %) continued in their studies after the first semester.

34 students wrote only pretest, 10 (29%) of them successfully passed the exam and 14 (41 %) continued in their studies after the first semester.

343 students wrote both pretest and posttest, 285 (83 %) of them successfully passed the exam and 293 (85 %) continued in their studies after the first semester.

With data from Table 2 we tested two kinds of hypotheses. Chi-square test of independence χ^2 is used to verify them; the tables with the data are Tables 5 and 6:

1. Null hypothesis $H_{0EX:}$

Number of students who will be successful in examination with participation in pretest and posttest will be the same as without participation in these tests.

Alternative hypothesis $H_{AEX:}$

Number of students who will be successful in examination with participation in pretest and posttest will be different from the group of students who did not participate in these tests.

2. Null hypothesis $H_{0CON:}$

Number of students who will continue their studies after the first semester with participation in pretest and posttest will be the same as without participation in these tests.

Alternative hypothesis $H_{ACON:}$

Number of students who will continue their studies after the first semester with participation in pretest and posttest will be different from the group of students who did not participate in these tests.

Both these kinds of hypotheses were tested with the chi-square test of independence $\chi 2$ (Chráska, 2007) defined in (**1**). The meaning of letters in the equation is seen in the schema of 4-field table (Table 4).

	α	**non α**	∑
β	a	b	a+b
nonβ	c	d	c+d
∑	a+c	b+d	n

Table 4: Schema of 4-field table

$$\chi^2 = n \cdot \frac{(ad-bc)^2}{(a+b)\cdot(a+c)\cdot(b+d)\cdot(c+d)} \quad (1)$$

	EXAM	nonEXAM	∑
Wrote NONE	15	167	182
Wrote IN+OUT	285	58	343
∑	300	225	525

Table 5: 4-field table for chi-square test of independence χ^2 - successfulness of students in passing the exam (for testing H_{0EX} and H_{AEX})

	CONT	nonCONT	∑
Wrote NONE	31	151	182
Wrote IN+OUT	293	50	343
∑	324	201	525

Table 6: 4-field table for chi-square test of independence χ^2 – continuing in studies after the first semester (for testing H_{0CON} and H_{ACON})

Tested hypothesis	**Default values**	**Tested criterion χ^2**
H_{0EX}	Table 4	272.012
H_{AEX}		
H_{0CON}	Table 5	235.378
H_{ACON}		

Table 7: The results of tested criterion χ^2 and default tables for tested hypotheses

In Tables 5 and 6 we see the values emerged from Table 2, with calculation of test criterion we tested the hypotheses. During testing, we compared the resulting values of the test criterion with its critical value. Critical tabulated value χ^2 for 1 degree of freedom and level of significance 5 % is 3.841.

Result for H_{AEX} is 272.012, for H_{ACON} it is 235.378, they are seen in Table 7.

Both results are highly more than the critical value. That means we can state:

1. We reject null hypothesis H_{0EX} and accept hypothesis H_{AEX}. The results are statistically significant.

2. We reject null hypothesis H_{0CON} and accept hypothesis H_{ACON}. The results are statistically significant.

Using of practicing materials

Furthermore we can see results of using different combinations of practicing materials (PM). Students could choose any type of offered PM and their combinations. As we expected, some students used also different types – they announced it in a posttest questionnaire. They were 22 and we did not include them into the statistics about effectiveness of using given materials. This means we continued the research with the group of 321 students.

In this paper we present (also shown in Table 8 with Figure 3 and Table 9 with Figure 4):

Amounts of students using each combination of PM

In Table 8 with Figure 3 we can observe three most frequent used combinations:

- 239 (74 %) students used Interactive computer auto-evaluation test (PC AET) or PC AET plus some other PM.
- PC AET was a favourite PM – mostly in combination with other PM, but also in use when students chose only one PM.
- 171 (53 %) students used Summary (S) or S plus some other PM.
- 115 (36 %) students used S and PC or S, PC plus Paper AET (PA AET).

Relation between using specified combination of PM and successfulness in exam

When we see (Table 9 with Figure 4) percentage successfulness in exam in each combination of PM, we see these three leading PM:

- PA AET with 92% successfulness in exam
- PA and PC AET with 87% successfulness in exam
- S and PC AET with 86% successfulness in exam

Relation between using specified combination of PM and continuing in studies after the first semester

In observing (Table 9 with Figure 4) continuing in studies after the first semester in relation to used combination of PM, we see these three main PM:

- S with 94% of students continuing in studies after the first semester
- All PM (this means S, PA and PC AET = ALL) with 90% of students continuing in studies after the first semester
- SPA+ with 89% of students continuing in studies after the first semester

	Used	EXAM	CONT
S	16	11	15
PA	13	12	11
PC	101	84	87
S+	171	142	151
PA+	106	90	92
PC+	239	202	206
SPA	40	33	35
SPA+	70	58	62
SPC	85	73	74
SPC+	115	98	101
PAPC	23	20	18
PAPC+	53	45	45
ALL	30	25	27
NONE	13	11	11

Table 8: Amounts of students using different combinations of practicing materials and their success in exam and continuing in studies after the first semester

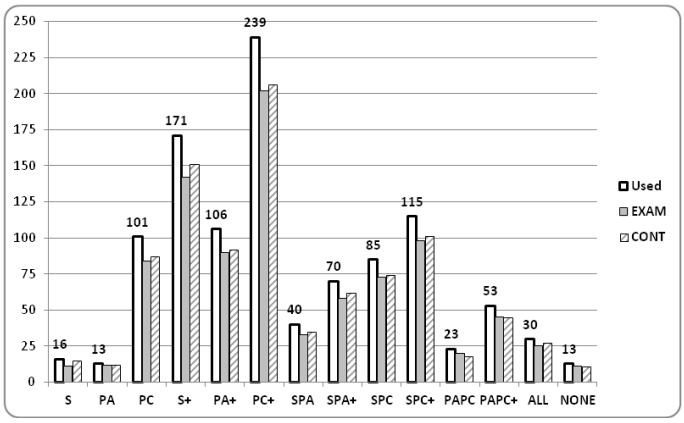

Figure 3: Graph of amounts of students using different combinations of practicing materials and their success in exam and continuing in studies after the first semester

	Used %	EXAM%	CONT%
S	100	69	94
PA	100	92	85
PC	100	83	86
S+	100	83	88
PA+	100	85	87
PC+	100	85	86
SPA	100	83	88
SPA+	100	83	89
SPC	100	86	87
SPC+	100	85	88
PAPC	100	87	78
PAPC+	100	85	85
ALL	100	83	90
NONE	100	85	85

Table 9: Amounts of students using different combinations of practicing materials in percent of each combination

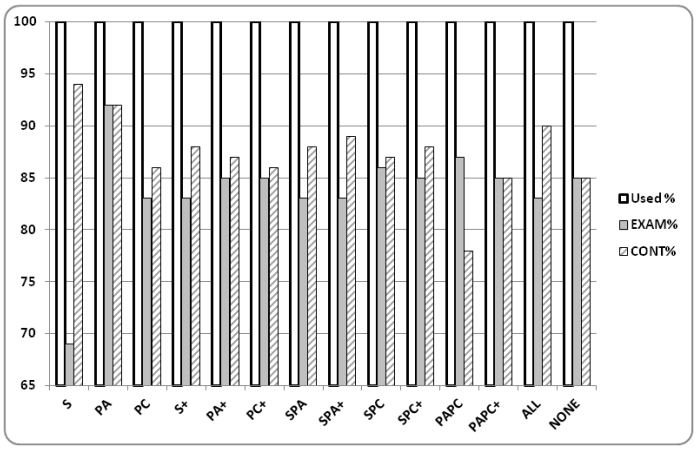

Figure 4: Graph of amounts of students using different combinations of practicing materials in percents of each combination

The results of the research showed the importance of involving students in research itself. Participation in the pretest greatly increased the success rate for the exam and the percentage of students who continued their studies after the first semester. This suggests the participation of all interested students to study and awareness of ongoing activities. Given the choice of PC AET was voluntary, and students who chose this kind of practice, were even several times better than in the beginning (the best improving was 267 %). The computer practical exercises had great educational significance. At the same time, however, the practice of traditional paper form had for students a positive effect on the outcome of the final test as well. Any method of practicing in our case had a positive impact on students' knowledge.

Discussion

Input and output tests with questionnaires were developed for the specific needs of students at the Faculty of Chemical Technology, they were not standardized. The requirements regarding the level of mathematics may be different at different schools and they could hardly be compared with other similar studies in terms of quantitative data.

However, an investigation of this method with respect to the size of the sample is of great importance. This confirms the importance of practicing with any of techniques and practicing with materials with ICT played an important role for those students who chose this method.

The best result with 92% successfulness in exam was with students who used PA AET. We can ask why just this kind of practicing had the best result. With careful using PA AET the study result can be very good. But the number of these students was 13 and it is statistically very small sample of the whole group Wrote IN+OUT of 343 people – less than 4 %. In the questionnaire in the posttest some students mentioned they had preferred this kind of practicing, it had been the best for them.

We would suppose the students using all practicing materials

will have the best results. The percentage of success in the exam respectively in continuing in study is not the highest, but is very high (83 %, resp. 90 %). So students had very good results – on the other hand using all kinds of materials need not mean using all of them carefully.

Special group of students are those who mentioned using no practicing material. They were 13. This is also a very small statistical sample – but suprisingly they have very good result in passing the exam and continuing in study (85 %). 11 of these students passed successfully the exam and continued studying after the first semester. Their average pretest result was 17.0 points. This number is highly greater than average pretest result of the *Wrote IN* group (it was 12 points). During personal asking some of them about no practicing they answered they had had no need to practice.

Those 2 students, who did not practice and did not pass successfully the exam and did not continue in their studies after the first semester, had their average pretest result 9.5 points. They answered they had not managed practicing.

Conclusion

We found the motivation for students to be involved in the pedagogical experiment was more successful than in the pilot study in 2011-12. 12 % more students of REG took part in the whole experiment.

We proved as statistically significant relation between taking part in the experiment and successful passing exam, respectively continuing in study after the first semester.

High percentage of students (74 %) used for their practicing Interactive Computer Auto-Evaluation test.

Data from the experiment are intended to use in another statistical research. We will search relation among using different types of PM and progress between pretest and posttest. Now we can present average improvement in group "Wrote IN+OUT" between these tests from 12 points in pretest to 17 points in the posttest (40 %). 137 students (42 %) improved these results more than 50 %.

The students, who had excellent results already in the pretest, e.g. 19-20 points, could have their posttest result maximally 5 % better. This group of students will be investigated separately in the dissertation.

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APPLICATION OF SENSORY MODALITIES IN A LANGUAGE LEARNING DIAGNOSTICS

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Highlights

- *Adaptive eLearning, adaptive instruction, sensory modalities, a learning style*

Abstract

This paper describes a theory of adaptive eLearning, a tool that enables an individualised instruction. First part of the paper focuses on a research review in the area of adaptive eLearning. Next, a theoretical model of adaptive eLearning is introduced.

The paper also deals with a possibility of adaptive eLearning use in a language learning relating to sensory modalities application in a language learning diagnostics.

Firstly, sensory modalities has been chosen from a basic classification of learning styles in a language learning. Moreover, a design of diagnostic placement test is presented along with characteristics of testing tasks with some of their examples. Secondly, the authors address content validity and reliability testing and scoring of the diagnostic placement test respecting recognized standards.

Last but not least, there is a reference to a suitable adaptive environment for general subjects instruction and a language learning diagnostics following student's dominant sensory modality which is explained in more details.

The diagnostic placement test is aimed to be a part of adaptive eLearning instruction system which is being designed and created at the Department of Information and Communication Technologies, Faculty of Pedagogy, University of Ostrava.

Article type

Full research paper

Article history

Received: January 29, 2014
Received in revised form: May 13, 2014
Accepted: June 16, 2014
Available on-line: July 31, 2014

Keywords

Adaptive eLearning, adaptive instruction, Common European Framework of Reference (CEFR), constant student's characteristics, a Diagnostic placement test (DPT), dynamic student's characteristics, a learning style, sensory modalities

Kostolányová, K., Nedbalová Š. (2014) "Application of Sensory Modalities in a Language Learning Diagnostics", *Journal on Efficiency and Responsibility in Education and Science, Vol. 7, No. 2*, pp. 44-52, online ISSN 1803-1617, printed ISSN 1803-1617, doi: 10.7160/eriesj.2014.070204.

Introduction

Regarding the changing environment in terms of using information technologies, there has been many attempts either from academic field or business field to use information technologies in learning instruction. As a reaction to these attempts there has been a project carried out at Ostrava University, called 'Adaptive individualised learning in eLearning' from 2009 to 2012. The aim of this project was to design a theory of adaptive eLearning, which meant to define the function of so called 'intelligent virtual teacher' that adapts the learning process automatically to students' personal knowledge and characteristics. Before the topic will be fully discussed several questions should be answered. These are as follows:

1. What needs to be detected about a student to start effective adaptive learning?
2. How do we detect the information about a student?
3. How shall we teach in adaptive eLearning?
4. How shall we define a structure of teaching support to be adapted according to student's characteristics?

While trying to answer these questions, other problems can be expected to appear.

In the Czech Republic the topic of adaptive eLearning has been discussed very little so far (2012). One example for all: Karel (2006) deals with the area 'Adaptability in eLearning'.

However, the topic has been discussed in a wider range abroad. Brusilovsky (2003) has been doing research for almost 20 years in the area of adaptive systems. In 1996 he published the article called 'Methods and techniques of adaptive hypermedia' which is the summary of knowledge about adaptive hypermedia until 1996. From his perspective adaptive system to be called adaptive must contain hypertext or hypermedia. What's more, there must also be a user platform and the hypermedia must be submitted to this platform. Brusilovsky also divided adaptive techniques in adaptive navigation and adaptive presentation. The idea of Brusilovsky approach to adaptive system can be seen in Figure 1.

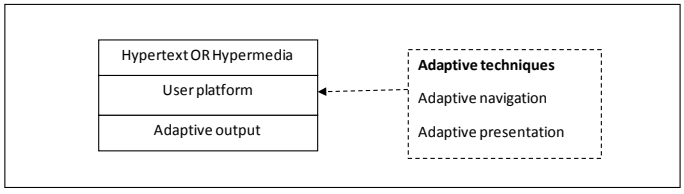

Figure 1: The idea of adaptive system from Brusilovsky perspective

From his many publications it is clear that the field of adaptive hypermedia systems has begun to be oriented on learning styles. Furthermore, web adaptive systems has been here for a long time. The first generation was based on adaptive presentation and adaptive navigation as mentioned above. They were focused on users' knowledge and objective simulation. The second generation of web adaptive systems widened the research field of adaptive hypermedia to explore an adaptation of content

choice and adaptive recommendation based on users' interests. The third 'mobile' generation pays attention to the place adaptation, time and a computer platform for general model and how to individualise widespread information technologies to user's needs (Brusilovsky, 2003).

The issue of adaptive instruction also appears in the article called 'Behaviour Based Adaptive Navigation Support' (Holub and Bielková, 2010). In the article the authors introduce the method how to support adaptive navigation and hypertext links in adaptive systems. Next article 'On the impact of adaptive test question selection for learning efficiency', by the same authors, informs about the method of adaptive selection of test questions according to individual student's needs in a web educational system.

The theoretical review above shows adaptive instruction has been widely discussed issue but it has been solved partially so far (adaptive navigation, adaptive presentation, adaptive selection of test questions, etc.).

The current findings must have been taken into account when designing a model of adaptive eLearning. The model is based on finding initial student's characteristics, creating adaptive study support and defining adaptive algorithms.

In the field of a language learning individualised approach has been discussed on the level of 'Computer language learning' (CALL), 'Mobile assisted language learning' (MALL) and 'Intelligent computer assisted language instruction' (ICALI).

In the field of a language knowledge testing terms as 'Computer assisted language testing' (CALT) or 'Computer based language assessment' (CBLA) appear. When talking about adaptivity in a language knowledge testing the term 'adaptive test' is used. The test detects a language level of a student in a way of submitting an easier or more difficult tasks on the base of student's answers (Fulcher 2010).

To create adaptive teaching materials in a language learning a theoretical basis for a design of multimedia language projects can be used. The core of any adaptive teaching materials should be the Second language acquisition model (SLA model). Long (1996) mentions the SLA model to be based on Krashen's idea who defines entries when learning a target language and how this entry to be processed by a student to influence his language skills positively.

The paper's objective is to introduce approach of application of sensory modalities in a language learning diagnostics in a continuity of Ostrava University project called 'Adaptive individualised learning in eLearning' where theoretical basis for adaptive eLearning of general subjects has been defined. The current model of adaptive eLearning must have been slightly adjusted for a language learning instruction. First adjustments are introduced in this paper in the form of detection of a student's characteristics together with existing language knowledge to begin an adaptive language learning process.

Materials and Methods

The system of adaptive instruction has been developed to serve adaptive general subjects instruction. General subjects are considered to be subjects like mathematics, biology etc. The system itself is comprised of 3 modules: an AUTHOR module, a STUDENT module and a TEACHER module. The AUTHOR module includes all the work connected with a design of adaptive study material. In the STUDENT module student's characteristics and a learning style is being diagnosed. Lastly, the TEACHER module controls the flow of adaptive study material based on detected student's characteristics and his learning style. The system of adaptive instruction is presented in Figure 2.

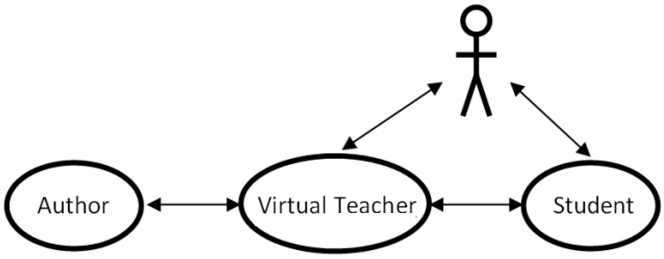

Figure 2: Adaptive instruction model

In the STUDENT module constant and dynamic characteristics of a student are detected both for general subjects as well as a language instruction. However, constant and dynamic characteristics differ in the content.

Constant characteristics detection for general subjects instruction is much more complex in comparison to constant characteristics detection for a language learning instruction. The difference in both approaches is discussed in more details in 'Discussion' section. The authors of original STUDENT module decided to design the particular elements in constant characteristics category to be more complex for the reason not to have such a clear guideline for choice as it exists in a language learning.

Furthermore, they aimed to include as many constant characteristics as possible to ensure at least some of chosen characteristics will help students to acquire better study results.

However, constant characteristics detection for a language learning instruction has been simplified and only sensory preferences has been chosen as a character of a study content in a language learning is structured by four language areas (reading, listening, writing and speaking. Proving the existence of interconnection between sensory modalities and particular language areas is a subject of further research described at the end of 'Discussion' section.

In the module STUDENT for general subject instruction there are three categories to detect student's characteristics (constant, variable and continuous monitoring of study activities). STUDENT module for a language learning instruction contains two categories only. These are constant and variable characteristics. These student's characteristics are aim to be acquired by a diagnostic placement test (DPT). The test detects both constant as well as dynamic characteristics of a student in one go.

The test has been designed respecting the language areas classification of the Common European Framework of Reference for Languages (CEFR) and analysis of learning styles and characteristics of a student.

It was also necessary to pay attention to result accuracy given by the DPT. The idea was to get a result about student's characteristics and existing language knowledge from all areas of a language at one go. Taking this fact into account there was a research carried out to detect how to acquire data about student's characteristics either by a psychological questionnaire or a placement language test to get more relevant data.

On the base of selected student's characteristics of a student, language areas and the research results a diagnostic placement test has been designed respecting the test reliability and scoring and content validity based on recognized standards.

Common European Framework of References for Languages (CEFR)

Common European Framework of References for Languages (CEFR) defines language competencies on each language level. These language levels are:

- A1 Beginner/elementary
- A2 Pre-intermediate
- B1 Intermediate
- B2 Upper-intermediate
- C1- C2 Advanced

Language skills according to CEFR are divided in two main areas. They are categorised and described as skills and are the subject of development by each student individually (Ivanová et al, 2002).

Receptive skills	*reading and listening*
Productive skills	*Speaking and writing*

Table 1: Language skills by CEFR (simplified version)

In Table 1 language skills of a student are divided into *receptive* and *productive* skills. By *receptive skills* we understand a language in a written and audio form. *Productive skills*, on the contrary, are meant to be language skills of a student to be able to express his ideas in both spoken as well as in a written form.

Analysis of learning styles and student's characteristics

Before the diagnostic placement test design, analysis of learning styles and student's characteristics must have been done so as to choose the most relevant learning style of a student or his characteristics to match language areas. The whole idea is presented in Table 2.

Shimojo and Shams (2001) divided learning styles in the three main categories. First category is called 'sensory preferences' also called 'sensory modalities'.

Visual, auditive and kinaesthetic students belong to the first category. Felder and Henriques (1995) define another type of a student which is called a verbal student. The speech of a verbal student is a reaction to what is heard or read. The authors also claim a kinaesthetic student to be more psychological type similar to introvert/extrovert category of Jung typology. On top of that, Friedman and Alley (1984) puts another type in sensory modalities category which is called visual-linguistic type. This type of a student likes to get information from a text reading and his knowledge is consolidated by a written form.

In 'Multisensory structured language teaching' visual, auditory and kinesthetic-tactile pathways are engaged simultaneously to enhance memory and learning of a written language by students with dislexia (Henry, 2009).

Vaseghi, Ramezani and Gholami (2012) have compiled past studies conducted on students' learning styles in a language instruction. In the paper they mention research results carried out on a worldwide level, in particular using Reid's Perceptual Learning Style Preference Questionnaire (PLSPQ) or VARK Learning Styles Model.

The second category is called 'psychological types'. Besides Shimojo and Shams (2001). Cohen and Weaver (2005) divide the psychological types in extrovert/introvert, random-intuitive/ concrete-sequential and closure-oriented/open-oriented types. Sadeghi et al (2012) review the relationship between learning styles, personality and reading comprehension in a language learning.

The third category is called 'cognitive learning styles'. By cognitive styles we mean the way of thinking, understanding and knowledge retention. Cohen and Weaver (2005) defined cognitive learning styles as global/particular, synthesizing/analytical, sharpeners/levelers, deductive/inductive, field-dependent, field-independent, impulsive/reflective, metaphorical/literal types.

More to say, sensory modalities are not separate modalities: plasticity and interactions have been found by neurobiological research done by Shimojo and Shams (2001) which supports suggested idea to help students with weak test results in one area of language by dominant sensory modality of a student.

A University of Pennsylvania psychology study (Thompson-Schill, Kraemer and Rosenberg, 2009), using functional magnetic resonance imaging (fMRI) technology to scan the brain, reveals that people who consider themselves visual learners, as opposed to verbal learners, have a tendency to convert linguistically presented information into a visual mental representation. In contrast those participants who considered themselves verbal learners were found under fMRI to have brain activity in a region associated with phonological cognition when faced with a picture, suggesting they have a tendency to convert pictorial information into linguistic representations.

Oxford and Ehrman (1992) have been dealing with learning styles in a language learning and matched a visual type of a student with the 'reading' language area.

Felder and Henriques (1995) add a comment to visual type of a learner who should learn better if he can see the new words first and then he hear them. The same happens with the auditive student but in a different order. By different order is meant to listen first and then to see the new words.

Oxford (in Felder and Henriques, 1995) confirms visual students to have a good ability to percept information from printed text plus other visual stimulus. On the contrary, visual students don't prefer written and spoken words but verbal students do.

Oxford (2003) claims that auditive students don't depend on visual support to understand what is said but it is not a rule. They prefer discussion and role-plays in the classroom and sometimes they have problems with written form of a task given.

Research introduction on how to test student's characteristics and a language level

The objective of intended research is to learn if it is of some benefit to place students in different study groups not only according to their language level but also according to their preferred sensory modality. The positive effect of this research is seen mainly in findings if students placed in different language level groups together with their preferred sensory modality will learn faster and with knowledge better retained. If the approach mentioned above does not bring positive results, it will signify that students' classification respecting to their preferred sensory modality does not positively impact their study results and thus should not be employed in a language learning instruction improvement.

Nowadays, a grammar placement test is used to classify an existing language level of a student which is considered to be sufficient for further language learning. Even highly recognized institutions in the field of a language learning and testing, for example Oxford University Press, which is a department of the University of Oxford, supports this way of testing. There are

recognized grammar placement tests sold by the university all around the world.

This fact shows outcomes making further study of a student difficult in other language areas as speaking, writing, reading and listening. Learning a foreign language is not only about grammar language level. As a result, all student's initial language skills are placed into one language level which doesn't correspond with reality of student's language knowledge across all language areas.

From my perspective, before students undergo adaptive language instruction (accommodated electronically), they take DPT and their 'real language level' is detected. Based on these test results, study materials matching preferred sensory modality of a student will be presented to him and a language area showing weak results will supported by dominant sensory modality. The main idea presented above is to discover a language level of a student in all language areas and making a further study of a student more effective in a way of speed and knowledge retention.

As a reflexion to these considerations a research was carried out in 2011 to bring results about possibility to use a language placement test to get information about student's sensory modalities and a language level from all language areas (which is reading, listening and writing) at one go. Testing of speaking skills is not included in DPT as current information and communication technology possibilities in language productive skills testing are very limited but not impossible. Recording student's voice and saving student's writing tasks into a database of adaptive eLearning for teacher's subsequent review is possible. However, not to omit testing of productive skills in adaptive eLearning completely, writing skills testing and learning has been retained which appeared to be less complicated in comparison to speaking skills testing and learning in the light of the whole issue discussed in this paper.

A psychological questionnaire acquiring information hasn't seemed to be a good choice because questions from psychological questionnaires return biased answers. On the contrary to psychological questionnaires, language tests return unbiased and measurable answers. A comparative research has been carried out where a psychological questionnaire and a language placement test has been used. The psychological questionnaire tested sensory modalities. Alongside with the psychological questionnaire the sensory modalities were tested using a language placement test covering language areas (listening, reading and writing). It has been done so because it is supposed that a language placement test covering all language areas will also reflect sensory modalities of a student. The presumed interconnection between sensory modalities and language areas is represented in the Table 2.

Language placement test areas	Sensory modalities of a student
Reading	Visual-linguistic type Friedman and Alley (1984)
Listening	Auditive type Oxford (2003)
Writing	Verbal type Felder and Henriques (1995)

Table 2: Interconnection between language placement test areas and sensory modalities of a student

Comparing results of a psychological questionnaire and a language placement test, there must have been a minimum request set for a correspondence between the psychological questionnaire and the language placement test results. The minimum request was set to 90% and higher which is considered to be a credible outcome.

Questions being part of used the psychological questionnaire were created by a psychologist Novotný (2010) and tasks for the language placement test were taken over from Test and Assessment CD-ROM which is a part of NEW ENGLISH FILE textbooks published by Oxford University Press.

The CD-ROM includes tests in a DOC format for teachers and can be adjusted according to teacher's needs. Reliability and content validity of testing tasks from this CD-ROM have also been surveyed.

Grammar school students and art secondary school students aged 15-18 years were the respondents in discussed research.

Design of a diagnostic placement test in a language learning

Table 3 shows the specifications preceding design of a diagnostic placement test in adaptive eLearning. The specifications for the test has been chosen on the base of didactic tests systemized by Chrástka (2007).

Classification standpoint	Test type
Characteristics of performance	The test measures a language level
Quality of a test preparation	Quasi-standardized
Characteristics of tested activities	Cognitive
Type of knowledge tested	Study results
Result interpretation	The test detects particular results (absolute performance)
Type of testing	Placement testing
Topic range	Summarizing
Objectivity of scoring	Quasi-scoring

Table 3: Classification standpoints to design a diagnostic placement test in adaptive eLearning

Diagnostic placement testing tasks reliability

Some standardized steps has been done to make testing tasks more reliable.

First, in multiple choice tasks (listening tasks and reading tasks) we put one extra option that excludes all the other options (option 'doesn't say' or 'none of the presented answers'). Respecting this approach a student will be motivated to think more deeply about the right answer.

Second possible approach to eliminate the negative effect of guessing is application of correction on guessing formula by Frary (1988) stated in number 1.

$$S = R - \frac{W}{n-1} \quad (1)$$

where

S= the score

R= the number of right answers

W= the number of wrong answers

n = the number of alternatives per item

To say it in more details, if I take a twenty-items, four option multiple-choice test and I score 12, the final result would be as you can see in formula 2, 3 and 4.

$$S = 12 - \frac{8}{4-1} \quad (2)$$

$$S = 12 - 2{,}67 \quad (3)$$

$$S = 9{,}33 \quad (4)$$

Diagnostic placement test reliability and scoring

Test reliability depends on quality and number of testing tasks. In the field of pedagogical diagnostics a coefficient 0,80 is required that means when the test is given to a student for the first time and for the second time, the results shouldn't differ more than max. 20% according to Chrástka (2007).

Binary scoring will be applied for this type of the test. It means 1 point for a correct answer and 0 point for an incorrect answer. No points are deducted for an incorrect answer. Exception will be applied in the grammar placement test as the test contains 20 questions. For the reason of total score of 10 points in all language areas, there will be 0,5 point for 1 correct answer.

Diagnostic placement test content validity

Testing tasks will represent a knowledge at certain language level.

DPT will include listening tasks, reading tasks, written tasks and grammar tasks in defined language levels according to CEFR (Common European Framework of Reference for Languages) standard.

Testing tasks are copied from Oxford University Press (OUP) testing materials CD-ROM for New English File book series. These tests are allowed to be modified by teachers for a testing purpose.

Results

Results on analysis of learning styles and student's characteristics

Learning styles corresponding with particular language areas (reading, listening, speaking and writing) has been chosen from the classification of learning styles. These are sensory modalities as a visual-linguistic learner, an auditive learner and a verbal learner. These sensory modalities will be used to design a diagnostic placement test.

Research results on how to test student's characteristics and a language level

Totally130 psychological questionnaires together with language placement tests have been handed out and filled in a relevant way by students. The purpose of this research was to find out which of these tools either a psychological questionnaire or a language placement test returns more relevant results about sensory modalities of a student. The results are as follows:

Personal type in the psychological questionnaire/ Language areas in the language placement test	Total number of students (tests filled in correctly)	Result correspondence: the psychological questionnaire and the language placement test	Result correspondence in %
Audial type/ Listening test	130	89	68
Visual type/ Reading test	130	56	43
Verbal type/ Writing test	130	97	75

Table 4: Presentation of research data

From the Table 4 it is clear that a correspondence of 90% between results of the both tests doesn't exist. The research proved the supposition that a psychological questionnaire isn't a suitable tool to define a personal type of a student, in our case, sensory modalities of a student. For this reason other tool returning more relevant outcomes about sensory modalities is needed. This tool is considered to be a designed diagnostic placement test.

Results on design a diagnostic placement test in a language learning

Based on analysis of student's characteristics, classification of language skills according to CEFR standard and the research comparing a psychological questionnaire and a language placement test results, a diagnostic placement test for adaptive eLearning has been designed. You can see the placement test below in Figure 2. In Figure 3, 4 and 5 there is a design of testing tasks.

In Figure 2 the diagnostic placement test is presented. The whole diagnostic process begins in the STEP I.A. In this step students are navigated to the next dialog box in the STEP II.A where they are instructed to choose their current knowledge of grammar at their discretion. In the STEP II.A there are hyperlinks to grammar tests based on a difficulty language level. In this step a student's grammar language level is diagnosed. In the STEP III.A students undergo listening, reading and writing placement test to detect their current language knowledge of remaining language areas. These results are also aimed to reflect sensory modalities of a student. In addition, more detailed explanation of one part of the test from the STEP III.A is demonstrated in the STEP IV.A. Finally, in the STEP V.A we can see an example of a student's language knowledge result also reflecting sensory modalities of a student.

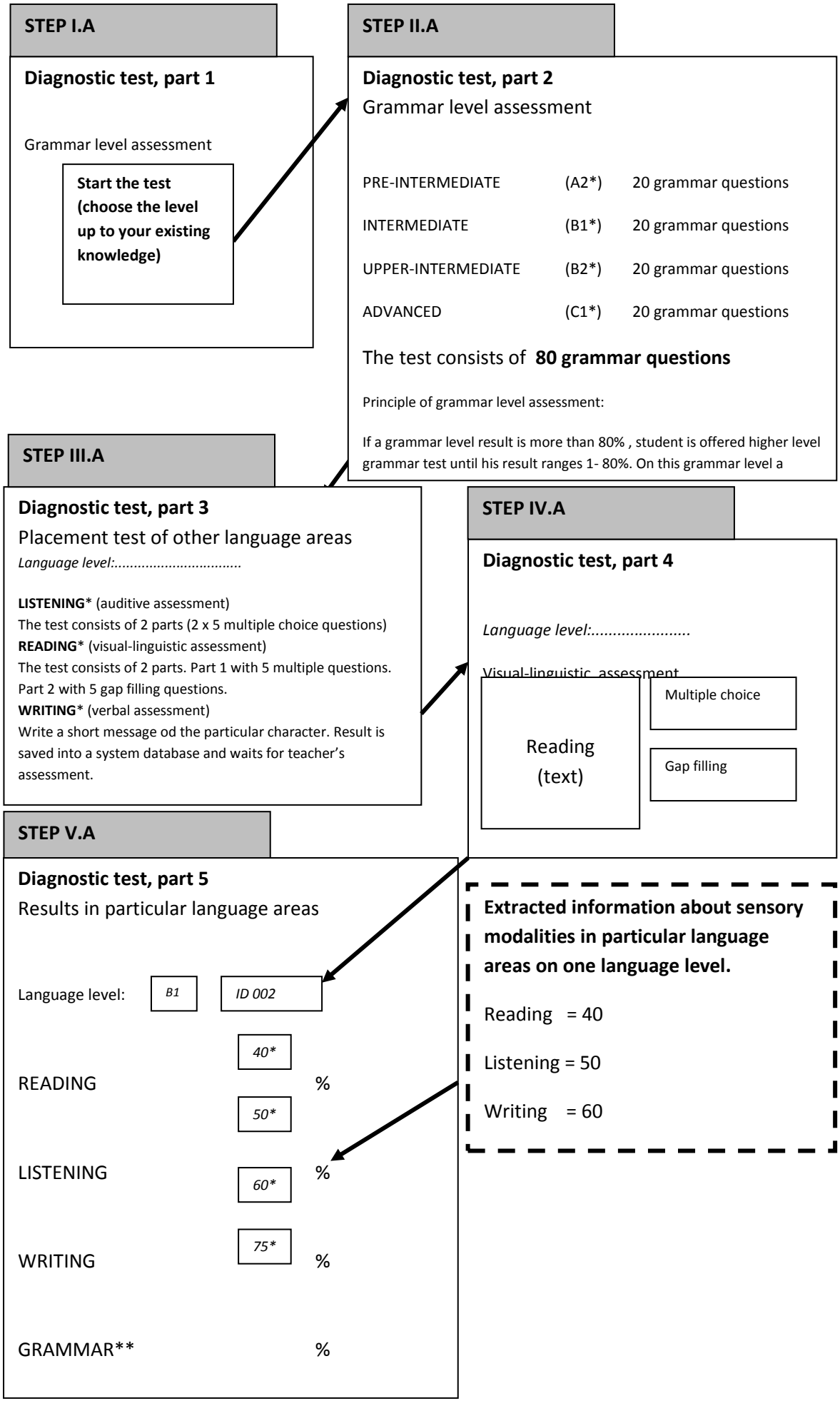

Figure 2: Design of a diagnostic placement test

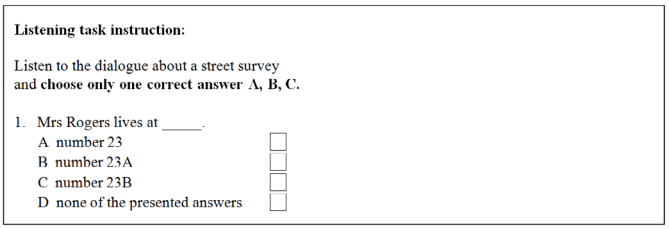

Figure 3: Design of a listening task in the diagnostic placement test

Figure 3 depicts an example of a listening task instruction in the diagnostic placement test. Presented listening task is of a multiple choice character. Getting the student to think more about the correct answer and to prevent thoughtless guessing an option D (none of the presented answers) is added to A, B, C options.

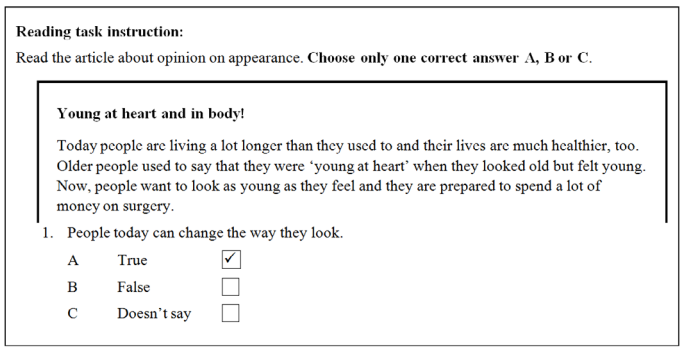

Figure 4: Design of a reading task in the diagnostic placement test

Figure 4 introduces a design of a reading task in the diagnostic placement test. The task consists of a text which is divided into parts together forming consistent story. After each part there is a question testing reader's text comprehension. A student can choose from three possible answers to go with each question.

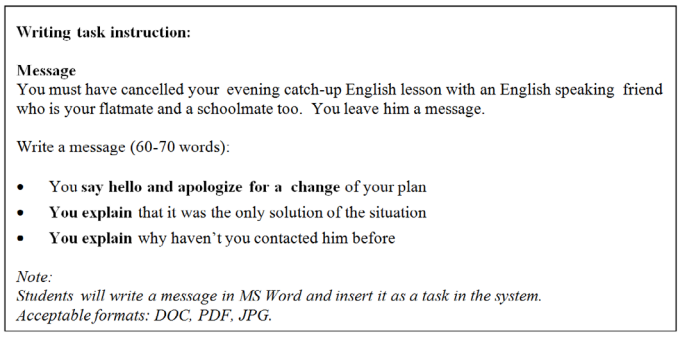

Figure 5: Design of a writing task in the diagnostic placement test

In Figure 5 a writing task instruction to test student's verbal language knowledge is presented.

Students are instructed to write a message in MS Word text processor and send it to a teacher for review. Acceptable formats are: DOC, PDF and JPG.

Diagnostic placement testing tasks reliability and scoring

See section 'Conclusion'

Diagnostic placement testing tasks content validity

See section 'Conclusion'

Discussion

Different approach of initial testing for general subjects and for a language learning

When comparing an initial testing approach for general subjects and for a language learning in adaptive eLearning some significant differences can be recognized.

The authors of adaptive eLearning for general subjects Kostolányová, Šarmanová and Takács (2009) divided the approach of getting information about a student in three categories. They are constant, variable and continuous monitoring categories of study activities.

The authors classify a sensory perception, a social aspect of study, study motivation, a systematic nature, way of ordering information, study techniques, study approach and a self-regulation to be part of a constant category. Testing these chosen constant characteristics, a psychological questionnaire was created by Novotný (2010) a psychologist from Ostrava University. There are 31 questions in the questionnaire with the answer key serving as a tool to get information about constant characteristics of each student. A part of this psychological questionnaire (specifically the sensory perception part) was used in the research to design a diagnostic placement test in a language learning. As we can see the authors chose many elements to be part of a constant category. Making the results from a psychological questionnaire more transparent a virtual student has been defined to gather similar student's characteristics. There has been a process designed on how to define a virtual student by data analysis from suitable questionnaires. Giving a questionnaire to a lot of students and with the help of clustering methods the groups with similar students would be created. Such a research has been carried out by Takács from Ostrava University but detection of significant groupings haven't been successful yet. For the time being (2012) a virtual student definition was put in charge of an expert teacher to set the parameters manually.

The variable characteristics are considered to be existing knowledge of a student in a particular subject. Their knowledge is tested in a form of a preliminary knowledge test consisting of questions which are corresponding with knowledge on certain level of a subject.

Continuous monitoring of study activities can serve not only for an ad hoc lesson but also for adjustment of initial student's characteristics or for monitoring of his study progress.

On the contrary to initial testing approach for general subjects, a diagnostic placement test in a language learning gathers information about a student from a constant as well as from a variable category at one go. It means the DPT compiles information about sensory modalities plus a language knowledge in all language areas (except of speaking). The continuous monitoring of study activities isn't included in a language learning test.

The diagnostic placement test is a tool to detect sensory modalities and a language knowledge of a student in three language areas. The evidence of interconnection between dominant sensory modality and better study results of a student in these three language areas (reading, listening, writing) is a subject of further research following after implementation, testing a functionality of a placement test and gathering data about students. After this phase, when detecting dominant sensory modality of a student, the student will be exposed to study material from all language areas but dominant sensory modality attributes will dominate in all these study materials.

For example: if a dominant sensory modality of a student is a visual modality, the student will prepare for a listening task in the form of learning new vocabularies or short sentence structures that appears in a listening task with the help of a visual support. However, the listening task itself will stay the same for all students not taking their dominant sensory modality into account. This has been done for the reason of reflecting reality where nobody exposes the foreigners who learn a language to the language content based on their dominant sensory modality. The main idea of the approach mentioned is preparing students for language tasks reflecting the use of a language in common life.

This approach should also prove if methods to design a diagnostic placement test has been chosen appropriately or inappropriately (in more details, if sensory modalities are somehow interconnected with language areas).

The diagnostic placement test might not meet the expectations of all students as for regarding the detection of their sensory modalities. The test will undergo a functionality testing which should reveal any failings in the presented test design. There should also be a cutting score defined to get through the test successfully. If majority of students manage to get through the test successfully, it will be assessed as an applicable diagnostic test for detecting sensory modalities and student's knowledge in adaptive language learning instruction.

Conclusion

The main idea of the diagnostic placement test in a language learning is to detect existing student's grammar knowledge with the help of a grammar placement test and then at this existing grammar level detect student's existing knowledge at reading, listening and writing language area.

Moreover, on the base of detected results at each language area at certain language level, the student will start his study at the beginning, in the middle of a language level or at the beginning of the following language level at certain language area. This method has been chosen to reflect the fact that a high level of language knowledge in one area doesn't automatically produce high level in other language skills. The student doesn't have to start his language instruction at the same point in all language areas. He can start to study at the beginning or in the middle within one language level or at the beginning of the next language level. Unfortunately, the diagnostic placement test doesn't allow the student to be placed to different language levels if his reading, listening and writing skills are rapidly different. If the test allowed such a knowledge placement, the results wouldn't be possible to use to detect sensory modalities. To detect sensory modalities the results must be acquired at one language level. The results of initial knowledge of a student in particular language areas will not be much misrepresented when tested on one language level as grammar knowledge reflects initial knowledge in other language areas to some degree. In other words, when learning a foreign language, grammar structures at given language level are reflected in reading, listening and writing study materials. For this reason when tested student's grammar knowledge together with other language knowledge at one language level there is a small probability for the student to get 0 points in the placement test. If so, there can be an algorithm added to the DPT where the student can be redirected to a preceding language level in a certain language area.

The outcome of the diagnostic placement test will be stated in percent in grammar, reading, listening and writing language areas at one language level. According to the total amount of percent in each language area the student will stay at established language level or will be placed to one language level higher or lower. The language levels are defined according to CEFR standard.

As a 'side effect' of this knowledge diagnostics will be detecting student's sensory modalities. The most significant sensory modality or better said attributes of this sensory modality of a student will be included in study materials throughout all language areas. The student then will be exposed to these study materials and it is expected there will be better study result for the students. Better study result in this case is meant to be acquired knowledge tested immediately after study unit and next acquired knowledge tested in time distance. To summarize what has been said above acquired knowledge immediately after a study unit and in time distance. In conclusion, acquired knowledge immediately after a study unit and in time distance is tested to prove better study result in a language learning.

Aspects of testing tasks reliability

Concerning of the diagnostic placement testing tasks reliability all testing tasks of DPT must be adjusted either adding one more option for each testing task excluding all the other answer options or applying the correction on guessing formula by Frary (1988). Both of these approaches should support the reliability of testing tasks of DPT and simultaneously make student's answers more accurate. Lastly, the reliability of all testing tasks should be tested twice to make sure the test returns the same or very similar results of each student.

Aspect of testing tasks content validity

If a content validity of tested tasks fails a different source of testing tasks must be chosen and not Oxford University Press (OUP) testing materials. However, regarding the fact Oxford University Press Publishing is a worldwide recognized institution, we can expect middle content validity of testing tasks and higher.

Aspect of a target group

There is also another aspect necessary to be taken into account and it is a target group of adaptive eLearning system. The diagnostic placement test should not only detect the reality of existing language knowledge in language areas (listening, reading and writing) but also to become an initial phase for individualised language learning.

Language teachers are aware of existence of different students' language skills in particular language areas, however, in a language classroom it is not possible to offer students a form of individualised learning. Instead, they apply only individual approach which can be considered insufficient in the light of students' differences when learning a foreign language.

The adaptive eLearning system could serve students at secondary schools to take catch-up lessons or to students at tertiary education system to be enrolled at lifelong learning programmes.

Acknowledgements

Our special thanks go to doc. RNDr. Jana **Šarmanová**, CSc. from Department of Information and Communication Technologies in Education, Ostrava University, who has been a part of the project 'Adaptive individualised learning in eLearning' and has contributed by many stimulating ideas to realise this project successfully.

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Publisher

Česká zemědělská univerzita v Praze (Czech University of Life Sciences Prague - CULS), 165 21 Praha 6-Suchdol, Kamýcká 129. E-mail sab@czu.cz

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