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A NEW APPROACH TO MEASURING OF COMPUTER LITERACY AT THE UWB

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Abstract

Nowadays, computer literacy is one of the required conditions demanded by an employer, who wants to success in today's labour market. Unfortunately a so called necessary minimum of knowledge is not exactly defined. Computer literacy is an important part of basic education in the Czech Republic. Our educators face a difficult issue of assessing a level of computer literacy among our students. Because of that, this case study compares two tools used for testing of computer literacy. We selected two testing tools for this study, the Original Testing System (OTS) and the Modified Testing System (MTS), and then investigated them thoroughly by quantitative comparison. This quantitative comparison of those testing tools was done using data collected from a freshman-level Word and Excel course in fall 2010 semester in the University of West Bohemia (UWB). Comparison was based on an analysis of the performance of 138 students attending this course. We analyzed correlations between scores from our two testing instruments. We conducted a paired sample t-test for the sake of comparison of the students' performance between their examination scores. This study has its limitations, which were discussed in the paper. Directions and recommendations for a future work were included based on those limitations.

Key Words

computer literacy, computer education, computer skills, assessment

Introduction

Information age is around us and more and more people are forced to live and work using information and communication technology. Because of this fast changing society and workplace, it is very important for citizens and employees to understand and be able to use a technology around them. But when can we say that a person is computer literate and when we cannot? That is the question. For everyone that line is somewhere else and unfortunately there is no uniform definition.

Question of knowledge and skill evaluation of students is very current nowadays, which is proved by current effort of Ministry of Education, Youth and Sports. It wants to initiate evaluation of students in fifth and ninth grade and initiate state graduation exams. The issue of evaluation is a cynosure even in foreign countries (Creighton et al., 2006). That is proved by existence of several institutions, specialized in this issue. They are for example Qualifications and Curriculum Development Agency, Education Testing Service, European Computer Driving License Foundation. Work on evaluation tool for measurement in an area of computer literacy started in 1983, when a team of experts was created. Their goal was not only to create a tool, but also to define the term computer literacy (Lockheed et al., 1983). Main accomplishment of this expert team was creation of evaluation tools set, that measured usage of particular computer programs, programming and knowledge of computer terminology in addition to social aspects of work with computer. Nowadays, two main approaches are chosen in an area of measurement of computer literacy. The first one is measuring computer literacy using self evaluation (Kontos G., 2007 or Berger C. F., Carlson E. A., 1988), the second one is focused on measurement using practical assignments (ECDL, 2010 or ETS, 2010). The second approach is dominant thanks to its focus and worldwide extension. Because of that, authors of this paper tend to prefer this approach of measurement.

Our educators face the challenging issue when they have to ascertain computer literacy level among our students. On account of that, a main purpose of this case study was to assess student's computer literacy using two different testing approaches. The particular objectives of this research were:

- To make a quantitative comparison of our two testing tools: the Original Testing System (OTS) and the Modified Testing System (MTS). And to examine advantages and disadvantages of each testing tool.
- To find out if in our case, there is any correlation between the OTS testing scores and the MTS testing scores.
- To find out if in our case there is any difference between the mean OTS testing scores and the mean MTS testing scores.

Material and Methods

"Computer literacy is a term that has been widely discussed, but whose meaning has rarely been agreed upon (Lockheed et al, 1983)." Those words remain as true today as they were when they were first written over a decade ago. The exact origin of the term computer literacy is unclear. Kurshan (in Hess, 1994) has reported that computer literacy courses were introduced at many colleges as early as 1965. The term computer literacy was also promoted in the early 1970s by Arthur Luehrmann in an effort to promote understanding of the uses of computers as opposed to the workings of computers. Luehrmann has also coined one of the more concise and pragmatic definitions of computer literacy (in Lockheed et al, 1983): "If you can tell the computer how to do things you want it to, you are computer literate." This definition has an advantage, because it admits a continuum of

computer skill levels and it also allows for a concept of computer literacy that is both technology and environment or context dependent. Computer literacy can thus be seen to comprise multiple elements ranging from a spectrum of skills for using a computer, to broader definitions that attempt to describe an impact of computers on society and changes in society wrought by an advent of the so-called "information age".

All freshman students at the Faculty of Education, University of West Bohemia are required to finish a basic common curriculum that includes courses in these areas of education: Math, Chemistry, Physics, Biology, Geography and other basic courses. In addition, all these students must finish the course called "Introduction to the Processing of Textual Information and Basics of Data Processing". Both courses are for freshmen students. Specifically, these courses are aimed to teach how to work with MS Word, MS Excel and MS Access. Students may use e-learning support, which were developed for both courses. This e-learning support contains a necessary expository text, which is completed by large amounts of multimedia elements (video sequences, animation). Thanks to these multimedia elements, learning is more effective and dynamic. For those who are interested, the e-learning support is available at: http://www.kvd.zcu.cz/cz/materialy/uzti7_kn/uzti/word_2007/index.htm - but only in Czech language.

The original testing system (OTS)

This testing system was developed at the Department of Computer Science and Educational Technology, Faculty of Education, University of West Bohemia. The major characteristic of the OTS is theoretical orientation on Word, Excel and Access. The OTS includes a test battery which offers a single choice (true/false questions) or multiple choice questions to the students. The OTS also contains two practical exercises which should validate the skills of students. One demerit of this system is that the correct or plausible answer by a student may be judged "incorrect" in some rare situations because of the fact that simulated environment may not be able to recognize the way of accomplishing the task.

As mentioned above, this testing system was created by employees of the KVD FPE. It was sometimes around a year 2000, when methodology of International Computer Driving Licence (ICDL) was not fully developed yet. Which is a main difference compared to undermentioned MTS testing system, that was created on basis of ICDL methodology. Also, when you consider current knowledge in the field, theoretical and practical part of OTS does not look valid enough. On the other hand, MTS attempts to reflect current viewpoints of computer literacy. Constructivism fundamentals are used to create its questions, which in addition to ICDL methodology should provide testing tool, which is valid enough for today's age.

The modified testing system (MTS)

The comparison tool for testing was the modified testing system (MTS). Basis of this system consists of the Computer Skills Placement (CSP) assesment (Computer Skills Placement, 2010). CSP was introduced in June (2006) at the ACCUPLACER conference. It was developed in collaboration with the CollegeBoard and ACCUPLACER as a component of the International Computer Driving Licence (ICDL), which is also called the European Computer Driving Licence (ECDL) Certification program (European Computer Driving Licence Foundation, 2010) and is based on the world's leading basic computer skills program that currently has over 6 million participants in over 140 countries. This system's theoretical part

is opposed to the OTS. It has moreover fill-in-blank questions, short answer questions and matching questions. Furthermore, the practical part of the MTS is connected to a MySQL database and is easily modifiable.

A testing system similar to MTS is Internet and Computing Core Certification (IC³). Internet and Computing Core Certification is designed to validate an individual's basic computer skills and Internet knowledge to promote success in school, work, and life (Certiport, 2010). This group of testing tools usually includes a set of skills and knowledge base, against which the test subjects would be compared. Although suppliers that provide the tests often claim that the tests can be adapted, adjusted or modified to fit the specific needs of the submitters, it seems that the customization is quite limited (if possible at all) compared to the first group of testing tools. The instructors would not have much need for a change of the tests and the administration of the exam would be therefore easier.

Research methodology

The research in this study is quantitative and is centered about the following research questions: Is there any correlation between testing scores of the OTS method and the testing scores of the MTS method? Is there any difference between the mean testing scores of the OTS method and the mean testing scores of the MTS method?

To assess the strength of the linear relationship between two test scores, Pearson's correlation coefficient (r) is used. And to find out statistical significance of r, we are using a t-test. The two hypotheses for this test are:

H_0: r = 0

H_a: r <> 0

If a p-value for this test is very low (for example less than 0.05), it would mean that there is evidence to reject the null hypothesis in favor of the alternative hypothesis. Other explanation is that there is a statistically significant relation between the two test scores.

On the contrary, for comparison of the means of two variables within a single group the paired-sample t test is used. Which means a paired t-test is usually used to compare means of the same or related subject over a period of time or in differing circumstances. In case of our study, it was used to determine if there was a statistically significant difference between the MTS test scores and the OTS test scores among our 138 students.

The paired t-test is in fact a test in which a difference between two observations is 0. In that case, if D stands for the difference between observations, the hypotheses are:

Ho: D = 0 (the difference between the two observations is 0)

Ha: D <> 0 (the difference is not 0)

The t is a test statistic with n -1 degrees of freedom. If the p-value conjugated with t is low (less than 0.05), there is a strong evidence for rejection of the null hypothesis. Therefore, we would have the evidence that there is a difference in means athwart the paired observations.

Results

In 2010, at the end of the fall, during winter semester, students from four classes of "Introduction to the Processing of Textual Information and Basics of Data Processing" were given two final exams: 30 questions and 2 practical exercises from the OTS and the MTS exam, which also consisted of 30 questions plus 2 practical exercises. The OTS exam was applied first. When the OTS exam finished, students were given codes to allow them to access the MTS exam. Students were made to believe that both test scores would be regarded with in calculating their final exam grade and final semester grade, which turned out to be a strong motivation.

All collected data were introduced into the STATISTIKA, a statistical and mathematical software package. We used descriptive statistics to analyze the data to get a demographic summary of 138 students. Then we used correlation and paired-samples T test in inferential statistics to test two pairs of hypotheses.

This study examined performance of 138 students in four classes in both courses. In the sample were more females (56.2%) than males (43.8%). The t-test was administered to test each of two pairs of hypotheses. The first pair of hypotheses examined if there is any correlation between the testing scores of the OTS test and the testing scores of the MTS test. The p-value was calculated from the test scores and any value less than 0.05, was rejected. First hypothesis was rejected solely on this basis. That was because there is the evidence to reject the null hypothesis in favor of the other hypothesis, or that there is a statistically significant connection between the scores of those two tests (see Table 1 for details).

		N	Correlation	Sig.
Pair 1	MTS score & OTS score	138	.724	.000 (**)

Table 1. Paired Samples Correlations

The second pair of hypotheses establishes if there is a statistically significant difference between the MTS test scores and the OTS test scores. A p-value was calculated from test scores and any value less than 0.05, was rejected. Second hypothesis was therefore rejected on this basis. That was because there is an evidence to reject the null hypothesis in favor of the other hypothesis, or that there is a statistically significant difference between the MTS test scores and the OTS test scores (see Table 2 and Table 3 for details).

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	MTS score	57.76	138	9.395	.818
	OTS score	67.45	138	9.640	.839

Table 2. Paired Samples Statistics

Paired Differences ((MTS_Score – OTS_ Score)					t	df	Sig. (2-tailed)
Mean	Std. devia.	Std. error Mean	95% Confidence Interval of the difference				
			Lower	Upper			
-9.689	7.071	.615	-10.907	-8.472	-15.743	131	.000(**)

Table 3. Paired Samples Test

** Difference is significant at the 0.01 level (2-tailed).

Discussion

Pearson's correlation was used for an evaluation of a linear relationship between MTS scores and OTS scores. In this evaluation a statistically significant linear relationship was discovered. Using Pearson's correlation coefficient, a relationship between OTS score and MTS score was $r(130) = 0.724$, $p < 0.001$. From these data, the mean (SD) for the MTS test is 57.76(9.395) and for the OTS test it is 67.45 (9.640). Because the p value is very close to 0.000, it seems that the two test scores are highly correlated. Even though we felt that the tests similar to the OTS may be superior to MTS (or resembling test tools), after three quantitative analysis, we feel that both testing tools could be viable options and can be used to a certain degree in some situations. For example we would recommend MTS (or resembling test) in case there are instructors available to slightly modify and customize the tests.

A cut-score logically need to be set if one of these tests is used for a bypass test as computer literacy requirement. Or if it is used as a testing tool for "credit-by-exam" classes. It always will be a challenging and difficult issue to do so, objectively and correctly (exactly the right number). Process of setting cut-score very much depends on capacity of educators involved and it is always a matter of judgment. Our suggestion is that the cut-score is set to be an equal to the mean plus standard deviation. Therefore, in case of the MTS test, we recommend that the cut-score should be set to 57.76 + 9.395 = 67.155 or 67, and for the OTS test, the cut-score should be set to 67.45 + 9.640 = 77.090 or 77.

This study was centered mainly on this two testing tools, the Original testing system (OTS) and the Modified testing system (MTS). We choose them both, because we think that they represent two main groups of testing tools very well. But on the market, there is yet another group of testing tools: Information and Communication Technology (ICT) Literacy Assessment (Honey, M., Pasnik, S. and Fasca, C., 2006). Two major examples from this group are iCritical thinking - Information and Communication Technology Literacy Test by Education Testing Service (Education Testing Service, 2010) and on-Screen Test for ICT at Key Stage 3 (National Assessment Agency, 2010, Qualifications and Curriculum Authority, 2010). The iCritical thinking (formerly known as iSkills or ICT Literacy Assessment), which was developed by Education Testing Service (ETS), is a comprehensive test of ICT proficiency originally aimed for higher-education environment. iCritical thinking test divides ICT literacy into seven key abilities: access, create, define, evaluate, manage, integrate and communicate. It is scenario-based test and it measures technological literacy. It means a measure of how well can students apply their computer skills and knowledge into real-life scenarios. That often includes sifting through multiple information resources and applications (like websites, emails, charts, spreadsheets, databases and search engines). After that, it needs to be decided which sources to use and then use them effectively. While we agree that goals of this test are a little lofty, the idea, in our opinion is very interesting and intensions of this test are certainly good. We still think that the ICT Literacy Assessment is much more involved and the students' performance may be affected very significantly by some other known factors (e.g., cognitive skills, critical and logical thinking skills, etc.) and maybe even some unknown ones. It is however difficult in this stage of research to compare these three approaches (e.g., compare iCritical thinking, OTS, and MTS) and analyze them quantitatively or qualitatively.

Conclusion

Based upon the results of our quantitative study, we concluded that the testing scores of the OTS and the testing scores of the MTS are highly correlated. We also concluded that there is a significant difference between the mean testing scores of the OTS and the mean testing scores of the MTS as administrated in UWB in fall 2010. We speculate that portable and mobile computing technologies are very much the defining technologies of this decade. The Internet has connected PCs around the globe, but PCs for the most part have remained stationary devices. Wireless technology truly frees laptops to be mobile, providing the ability to connect to the Internet from anywhere and at any moment. Portability frees an application from a particular platform at a particular location. In essence, portability and mobility imply access to information and the ability to communicate from any place and at any time (Hoffman, 2003). In this regard, we think a so called system of cloud computing will be supported more widely.

We can anticipate an advancement in definition of computer literacy in this context. Transfer of education materials into electronic form can be expected, because of need to use them in mobile devices (PDA, cell phones, Ipads,…). This need will be very challenging for researchers involved in this study. Because of it, they will be forced to transfer e-learning courses (didactic tests), they are currently using, to the needs of today's mobile devices. At the present time, we are undergoing quasi-standardization of the MTS test and we know already, that we will have to adjust some parts of it, which we discovered during evaluations. There were elements of the test, which were too difficult or by contrast too easy. Evaluations of the MTS tests were done in agreement with methodology used in Chráska (1999) and Gavora (2000). In the next semester, there will be a verification of the problematic parts in tests, that were now adjusted. And simultaneously, as was noted above, we will need to think up a modification of test, which will put much more emphasis to ability of using internet browser. It will open a gate to future full use of cloud computing.

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