A STUDY OF COMPUTER LITERACY AMONG CROATIAN STUDENTS AS SUPPORT IN PLANNING THE HIGHER EDUCATION DEVELOPMENT

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Computer literacy is essential in today's world. Particularly college and university graduates are expected to possess adequate knowledge and skills in using information and communication technologies (ICT). Starting from this premise, this paper presents the results of the research conducted in order to determine computer literacy levels among Croatian students. In the analysis special emphasis was given to examining the differences in computer literacy between polytechnic and university students. For this reason inferential statistics methods played a key role in the analysis. Research results have shown that students assess their general ICT competencies with relatively high grades, whereas advanced computer usage received lower grades. Furthermore, while university students gave higher grades to their general computer skills, polytechnic students gave higher grades to advanced skills. The analysis examined also the differences according to gender and year of study. Given that this paper identifies the areas of computer literacy that need to be improved, it can be viewed as support in planning the development of higher education. It should be noted, however, that the obtained results must be taken with a certain reserve, since ICT knowledge and skills were not examined directly in controlled conditions; rather, the insights given here are based on respondents' self-assessment.

Keywords: computer literacy, Croatian students, development planning, higher education, inferential statistics

Studija računalne pismenosti hrvatskih studenata kao podrška planiranju razvoja visokog obrazovanja

Računalna pismenost danas je esencijalna. Poglavito se od visokoobrazovanih osoba očekuje da posjeduju primjerena znanja i vještine iz područja korištenja informacijskih i komunikacijskih tehnologija (ICT). Polazeći od toga, u ovom su radu prezentirani rezultati istraživanja provedenog s ciljem utvrđivanja razine računalne pismenosti hrvatskih studenata. U analizi je poseban naglasak stavljen na ispitivanje razlika u računalnoj pismenosti između veleučilišnih i sveučilišnih studenata. Stoga su ključnu ulogu u analizi imale metode inferencijalne statistike. Rezultati istraživanja pokazali su da studenti svoje opće ICT kompetencije ocjenjuju relativno visokim ocjenama, a napredne oblike korištenja računala nižim ocjenama. Analiza je nadalje pokazala da sveučilišni studenti većim ocjenama ocjenjuju svoje osnovne računalne vještine, a veleučilišni studenti napredne. U okviru analize također su ispitane razlike s obzirom na spol i upisanu godinu studija. Budući da identificira područja računalne pismenosti koja je nužno unaprijediti, ovaj rad predstavlja podršku planiranju razvoja visokog obrazovanja. Nužno je naglasiti da dobivene rezultate treba uzeti s obzirom budući da ICT znanja i vještine nisu ispitane neposredno i u kontroliranim uvjetima, već su spoznaje o njima temeljene na samoprocjeni ispitanika.

Ključne riječi: računalna pismenost, hrvatski studenti, planiranje razvoja, visoko obrazovanje, inferencijalna statistika

1
Introduction

The development of ICT and their implementation in virtually all segments of human activities made their use and related skills indispensable. It is not surprising that over the past few decades traditional literacy has been supplemented by computer literacy when speaking about the preconditions an individual needs in order to participate in modern society. Given the importance of ICT, it would not be exaggerated to conclude that today computer literacy is equally important as reading and writing.

Computer literacy has been defined in a variety of ways. Reynolds and Fletcher-Janzen [1] point out that the problem of defining this notion arises from the fact that individuals with different educational levels have differing computer needs. However, it would be misguided to conclude that computer literacy as we understand it is determined solely by the level of education. The perception of computer literacy depends primarily on personal and professional needs of each individual, but also on a range of other factors. Still, it is possible to single out some universal features of this notion. For Englebardt and Nelson [2] computer literacy represents the ability to acquire and apply a basic understanding of current computer hardware systems and software applications to a problem in a particular work or personal setting. According to Mehlenbacher [3]

computer literacy is most frequently defined as the ability of learners to work with particular operating and programming environments, applications, and software configurations. Bidgoli [4] defines computer literacy quite simply as the basic knowledge needed for understanding and using computers for day-to-day tasks. As computers are increasingly being used for Internet access and searching for information via the Internet, it has become essential to have basic knowledge about the Web and Web technologies. Consequently, these skills can also be included in general computer literacy.

Computer literacy is crucial for improving the professional competencies of students, and thus for their success. To prepare students for life and work in an ICT-dominated environment, it is necessary to develop educational programmes that comprise computer skills acquisition. In technologically developed countries computer literacy has long been an important part of the curriculum in higher education institutions. Less developed countries are following suit and increasingly see ICT as an opportunity for general advancement and a tool for addressing the problems that plague them.

The main purpose of this paper was to establish the levels of computer literacy among Croatian students and to examine the differences in ICT knowledge and skills between students at polytechnics and those at universities. By determining the current situation we aim to contribute to better planning of higher education development and its improvement. In the analysis of the stated topic we first

provide a brief overview of the system and organisation of the Croatian higher education. This is followed by a review of available literature presenting the research on computer literacy of student population. The central part of the paper is dedicated to the results obtained in the survey conducted among students of the Polytechnic in Varaždin and Josip Juraj Strossmayer University in Osijek.

2
Croatian higher education system

Over the past decade the Croatian higher education system has gone through a process of comprehensive reforms, which were undertaken with a view to accelerate the inclusion of local research and teaching activities into European and world integration flows. Some major reasons for initiating the reform were a relatively small percentage of students completing their studies, excessive duration of studies, low student and teacher mobility, as well as the necessity to create a transparent and efficient quality assurance system that would make Croatian diplomas recognizable and internationally accepted. To this we might add the obvious uncompetitiveness of the Croatian higher education system, which lacked appropriate connectedness with the business world. The first significant step towards improving the higher education system was taken in 2001 when the Republic of Croatia signed the Bologna Declaration. Study programmes were aligned with the Bologna process requirements from the academic year 2005/2006. [5] One of the most obvious results of the Bologna process was the introduction of ECTS points and providing graduates with diploma supplements.

There are different types of higher education institutions in Croatia, ranging from universities that are comprised of faculties and academies of arts, to polytechnics and colleges. Whereas universities can found and have within their structure faculties, academies of arts, departments and other units, polytechnics and colleges cannot be founders of other higher education institutions. In the Republic of Croatia higher education is delivered through university study programmes and professional study programmes. University study programmes aim to educate and train students for performing jobs in science and higher education, in the business world, public sector and society in general, enabling them to develop and apply scientific achievements and latest professional standards. Professional study programmes, organized and delivered at polytechnics and colleges, have the task to provide students with adequate levels of knowledge and skills that will enable them to perform work in qualified positions. Exceptionally, professional study programmes can be delivered also at universities [6].

In the academic year 2010/2011 there were 9 universities (7 public and 2 private ones), with 82 faculties and 6 academies of arts, 15 polytechnics and 30 colleges functioning in the Republic of Croatia. Higher education institutions had a total of 148 616 enrolled students in the academic year 2010/2011. Out of this number, polytechnics accounted for 24 122 students (16,2 %), colleges accounted for 9 539 students (6,4 %),

faculties had 113 012 students (76 %), and academies of arts 1 943 students (1,3 %). During the year 2010 there were 32 378 students who graduated from Croatian higher education institutions. Out of this total number, 3 310 students (10,2 %) graduated from polytechnics, colleges had 1 768 graduates (5,5 %), faculties accounted for 26 662 graduates (82,3 %), and academies of arts for 638 (2 %). It should be noted here that the number of 26 662 students who graduated from faculties can be broken down into 22 041 who completed university study programmes and 4 621 of those who completed professional study programmes [7].

3
An overview of literature dealing with computer literacy among students

As computers came into wider use in 1980s, there were also first studies aimed at determining computer literacy among students. The new millennium witnessed a growing interest in such research. We will briefly present some of the available studies of computer literacy among students, which were published over the last decade.

Lesjak et al. [8] looked into computer literacy of students in Slovenia. Their study revealed a significant degree of computer literacy, especially in the areas of word processing, spreadsheets, and Internet features; there was also a positive impact of information technology penetration into the Slovenian society. The authors found substantial differences among students coming from various schools/regions.

In their paper Bulgiba and Noran [9] presented the study of IT usage, perceptions and literacy of medical students in Malaysia. The highest skills relate to Internet use and word processing, however, the use of databases and statistical packages is much weaker.

The study of Miletić and Grga [10] aimed to investigate computer literacy and Internet use among dental students in Serbia. The majority of students believed PC skills to be important for dentists. Students who took the Informatics course were more proficient in using computers compared to those who did not complete this course.

Hoffman and Vance [11] conducted a survey of incoming first-year students at an American university to learn not only their skill level in certain technology tasks, but also from whom they learned these tasks. The skills were grouped into three clusters. The first, high skill level cluster included technology tasks that students wanted to know, such as participate in instant messaging, connect from home, and search. In the middle skill level cluster there were technology tasks that students needed to know, such as creating folders on a computer and creating presentations. The third, low skill level cluster was comprised of tasks that most students considered optional, such as creating Web pages.

Wallace and Clarine [12] investigated whether American incoming students had adequate computer knowledge and skills to be exempt from the introductory computer fundamentals course. Students were tested on both computer skills and computer concepts that they were expected to master at the completion of such a course. As the students' average test scores were

significantly below passing, the authors concluded that freshman students needed an introductory computer course that included both Information Systems (IS) concepts and Information Technology (IT) software applications.

The main purpose of the paper by Hsiao and Lin [13] was to understand the computer literacy of college students in Taiwan and to analyze the important factors influencing their computer literacy. Among other findings, the authors established that computer literacy of male students exceeded that of female students except for security and ethics categories. In addition, the study revealed that students graduating from private schools outperformed their counterparts from public schools when it came to computer literacy.

In order to investigate the perception of computer literacy among Jordanian EFL students, Bataineh and Baniabdelrahman [14] surveyed a sample of 210 respondents. The findings revealed that the majority of students reported being fairly proficient in computer skills such as deleting files, formatting a floppy disk and installing a program on a hard disk. Most reported being less proficient in computer skills such as using images from a camcorder or digital camera in computers, using PowerPoint and creating databases. The results further revealed no significant effect for gender; on the other hand, the year of study influenced the perception of own computer literacy.

The aim of the study by Divaris, Polychronopoulou and Mattheos [15] was to assess objectively the computer literacy and attitudes in a group of Greek post-graduate dental students. Multivariate analysis revealed 'gender', 'e-mail ownership' and 'enrolment in non-clinical programs' as significant predictors of computer literacy.

McDowell and Xiping [16] examined the changes in computer literacy of undergraduate nursing students over a period of eight years. The results showed a significant increase in skills such as word processing, e-mail and the Internet. The areas with no significant improvement were using spreadsheets, databases and statistical programs.

The paper by Tella and Mutula [17] presents findings of a study carried out at the University of Botswana to determine gender differences among undergraduate students with regard to computer literacy. The results suggest that there are differences between female and male undergraduate students, indicating an overall advantage of male students.

Smith et al. [18] investigated computer literacy and attitudes of dental students and staff at the University of the West Indies, located in Trinidad and Tobago. Comparing their results with similar studies in the US and Europe, the authors concluded that computer literacy of the staff and students was more than adequate. However, older staff members had significantly lower computer literacy when compared with younger age groups.

In the research conducted by Nash [19] it was established that South African incoming students had adequate computer skills. The results revealed that skills were strongest in areas relating to information access and communication, and weakest in using word processing and spreadsheet applications.

The main purpose of the study conducted by Osuji [20] was to find out the extent to which Nigerian ODL (Open and Distance Learning) students were computer literate. The results revealed that the levels of computer literacy in the observed student population were weaker than expected. Overall men achieved higher scores than female students.

Some of the results and conclusions are very similar across all the presented studies, but there are significant differences as well. The results should, of course, be interpreted in light of the specific features of educational systems in which a particular research was conducted.

4
Instrument, sample and methods

Our research encompassed 378 students of Polytechnic in Varaždin (48,6 %) and 400 students of the Josip Juraj Strossmayer University in Osijek (51,4 %). Students at Polytechnic in Varaždin were surveyed by means of a written questionnaire, whereas with students in Osijek we used both a written and an online questionnaire. The questionnaire consisted of a larger number of items, and this paper deals only with those relevant for the topic under consideration. The first part of the questionnaire consisted of sociodemographic variables. Then followed the items that intended to establish how Croatian students perceive the quality and conditions of studying, and how they assess the knowledge and skills acquired in the course of their education. These questions included those referring to self-assessment of their own computer literacy.

The total sample consisted of 377 male students (48,5 %) and 401 female students (51,5 %). Tab. 1 shows the distribution of students according to higher education institution and gender.

Table 1 Respondents according to higher education institution and gender

Higher education institution	Gender		Total
	Male	Female	
Polytechnic in Varaždin	211	167	378
Column percent	56,0 %	41,6 %	
Row percent	55,8 %	44,2 %	
University in Osijek	166	234	400
Column percent	44,0 %	58,4 %	
Row percent	41,5 %	58,5 %	
Total	377	401	778

Table 2 Respondents according to higher education institution and year of study

Higher education institution	Year of study		Total
	1st	2nd and 3rd	
Polytechnic in Varaždin	284	94	378
Column percent	66,0 %	27,0 %	
Row percent	75,1 %	24,9 %	
University in Osijek	146	254	400
Column percent	34,0 %	73,0 %	
Row percent	36,5 %	63,5 %	
Total	430	348	778

Among the respondents from the Polytechnic in Varaždin there were more male students, whereas in the sample from the Josip Juraj Strossmayer University in Osijek there were more female students. This ratio is

consistent with overall numbers in Croatian higher education: male students outnumber women at polytechnics, and at universities it is the other way round (in total there are more female students in Croatian higher education).

In our sample there were 430 respondents who were enrolled in the first year (55,3 %) and 348 were second-

and third-year students (44,7 %). To bring the analyzed groups into alignment, the sample from the Josip Juraj Strossmayer University in Osijek consisted only of undergraduate students and students of integrated programmes enrolled in first three years of study.

Table 3 Descriptive statistics referring to computer literacy

Computer skill / competence	Mean	Median	Mode	Standard deviation	Coefficient of variation
General computer literacy	3,78	4,00	4,00	0,84	22,34
Word processing	4,28	4,00	5,00	0,79	18,42
Presentations	4,10	4,00	5,00	0,94	22,93
Spreadsheets	3,25	3,00	3,00	1,15	35,37
Using Internet browsers	4,58	5,00	5,00	0,78	17,05
Using e-mail	4,57	5,00	5,00	0,75	16,39
Drawing / designing	3,18	3,00	3,00	1,29	40,59
Using statistical packages	1,69	1,00	1,00	0,91	53,96
Using mathematical packages	1,86	1,00	1,00	1,05	56,76
Multimedia	2,99	3,00	3,00	1,31	43,72
Working with databases	2,32	2,00	1,00	1,16	49,91
Programming	2,16	2,00	1,00	1,19	55,22
Creating websites	2,10	2,00	1,00	1,28	61,33

The respondents from the Polytechnic in Varaždin were predominantly first-year students, whereas respondents from the Josip Juraj Strossmayer University in Osijek were mostly students from higher years.

The data were analyzed using the methods of descriptive and inferential statistics. Statistical significance of differences was tested by means of the Mann-Whitney test. Differences were considered significant at the level $p < 0,05$. The software used was the statistical package STATISTICA.

5
Results

Within the questionnaire students were asked to assess their general computer literacy as well as particular skills and competencies in using computers. The

responses were measured on a five-point Likert scale (1 = lowest rating, 5 = highest rating). Tab. 3 contains the basic descriptive statistics calculated for the variables thus defined.

Among our respondents, general computer literacy was rated with the average grade of 3,78. The highest average grades were given to skills in using Internet browsers and e-mail. As expected, there were relatively high average grades for word processing skills and creating presentations. Medium average grades were given to the skills such as working with spreadsheets, computer drawing and designing, and working with multimedia. The lowest average grades were calculated for using statistical and mathematical packages, and relatively low grades were given to skills in programming and working with databases.

Table 4 Descriptive statistics with regard to the higher education institution and results of Mann-Whitney test

Computer skill / competence	Higher education institution				Mann-Whitney test			
	Polytechnic in Varaždin		University in Osijek		Mean rank		Z	p
	Mean	Median	Mean	Median	Polytechnic in Varaždin	University in Osijek		
General computer literacy	3,92	4,00	3,65	4,00	420,45	347,97	4,828	0,000
Word processing	4,21	4,00	4,35	4,00	370,70	407,27	−2,480	0,013
Presentations	4,01	4,00	4,18	4,00	370,37	407,58	−2,464	0,014
Spreadsheets	3,09	3,00	3,41	3,00	359,42	417,93	−3,745	0,000
Using Internet browsers	4,56	5,00	4,60	5,00	383,17	395,48	−0,955	0,339
Using e-mail	4,49	5,00	4,65	5,00	370,00	407,93	−2,905	0,004
Drawing / designing	3,12	3,00	3,24	3,00	379,99	398,49	−1,175	0,240
Using statistical packages	1,78	2,00	1,60	1,00	414,27	366,09	3,320	0,001
Using mathematical packages	1,92	2,00	1,79	1,00	401,39	376,38	1,681	0,093
Multimedia	3,21	3,00	2,78	3,00	425,28	353,93	4,534	0,000
Working with databases	2,36	2,00	2,29	2,00	397,62	378,04	1,261	0,207
Programming	2,26	2,00	2,06	2,00	409,94	370,18	2,585	0,010
Creating websites	2,14	2,00	2,05	2,00	396,31	383,06	0,874	0,382

Table 5 Descriptive statistics for male students in the analyzed institutions and results of Mann-Whitney test

| Computer skill / competence | Higher education institution | | | | Mann-Whitney test | | | |
| | Polytechnic in Varaždin | | University in Osijek | | Mean rank | | | |
	Mean	Median	Mean	Median	Polytechnic in Varaždin	University in Osijek	Z	p
General computer literacy	4,19	4,00	3,76	4,00	209,32	155,27	5,161	0,000
Word processing	4,34	4,00	4,20	4,00	194,66	181,80	1,246	0,213
Presentations	4,11	4,00	4,01	4,00	191,35	186,02	0,501	0,617
Spreadsheets	3,45	3,00	3,36	3,00	192,11	185,05	0,645	0,519
Using Internet browsers	4,70	5,00	4,58	5,00	192,44	184,63	0,897	0,370
Using e-mail	4,54	5,00	4,54	5,00	189,59	188,25	0,143	0,886
Drawing / designing	3,41	3,00	3,17	3,00	197,56	178,12	1,763	0,078
Using statistical packages	1,88	2,00	1,50	1,00	210,34	161,88	4,740	0,000
Using mathematical packages	2,23	2,00	1,83	1,00	206,72	166,47	3,760	0,000
Multimedia	3,46	4,00	2,57	3,00	220,25	148,34	6,519	0,000
Working with databases	2,49	2,00	2,24	2,00	200,58	174,28	2,407	0,016
Programming	2,58	3,00	2,14	2,00	206,66	166,55	3,663	0,000
Creating websites	2,47	2,00	2,14	2,00	200,56	174,30	2,414	0,016

The median value 5 was determined for skills and competences in using Internet browsers and e-mail, and value 1 for using statistical and mathematical packages. The coefficients of variation indicate a significant dispersion of student ratings, which refers particularly to the following skills: creating websites, using mathematical packages, programming and using statistical packages. Student ratings were more uniform with regard to using e-mail, Internet browsers and word processing.

In order to examine whether the differences in computer literacy ratings between students at Polytechnic in Varaždin and those at the Josip Juraj Strossmayer University in Osijek were statistically significant, we used the Mann-Whitney test. In addition to test results, Tab. 4 lists also the values of means and medians calculated for both student groups.

General computer literacy was given a higher average rating by students at Polytechnic in Varaždin than by students in Osijek. For polytechnic students in Varaždin higher average grades, as well as higher mean ranks were also determined for all the advanced computer skills, with the exception of drawing/designing. Standard ICT tools (word processing, creating presentations, working with spreadsheets, using Internet browsers and e-mail) were rated more highly on average by students at the Josip Juraj Strossmayer University in Osijek. According to the Mann-Whitney test, the following differences are significant: general computer literacy, word processing, creating presentations, working with spreadsheets, using e-mail, using statistical packages, working with multimedia, and programming.

Tab. 5 shows the descriptive statistics for male students at Polytechnic in Varaždin and the Josip Juraj Strossmayer University in Osijek, as well as the results of the Mann-Whitney test. Students at Polytechnic in Varaždin gave higher average grades to all ICT skills and competences, including general computer literacy, which yielded also higher mean ranks. The Mann-Whitney test indicated that there were significant differences between male students of these two institutions in their rating of general computer literacy and in advanced computer skills, with the exception of drawing/designing. This result can be explained by the fact that male respondents in the polytechnic sample were mostly students enrolled in technical fields, and as such more familiar with ICT.

Table 6 Descriptive statistics for female students in the analyzed institutions and results of Mann-Whitney test

| Computer skill / competence | Higher education institution | | | | Mann-Whitney test | | | |
| | Polytechnic in Varaždin | | University in Osijek | | Mean rank | | | |
	Mean	Median	Mean	Median	Polytechnic in Varaždin	University in Osijek	Z	p
General computer literacy	3,58	4,00	3,58	4,00	199,86	196,72	0,289	0,772
Word processing	4,05	4,00	4,45	5,00	172,59	221,28	–4,529	0,000
Presentations	3,89	4,00	4,29	4,00	177,02	218,11	–3,750	0,000
Spreadsheets	2,63	3,00	3,44	3,00	156,50	232,76	–6,699	0,000
Using Internet browsers	4,38	5,00	4,61	5,00	186,64	211,25	–2,540	0,011
Using e-mail	4,43	5,00	4,73	5,00	178,62	216,97	–4,107	0,000
Drawing / designing	2,75	3,00	3,28	3,00	174,15	220,16	–4,012	0,000
Using statistical packages	1,66	1,00	1,68	1,00	200,63	201,27	–0,060	0,952
Using mathematical packages	1,53	1,00	1,77	1,00	184,33	211,05	–2,550	0,011
Multimedia	2,89	3,00	2,93	3,00	198,32	202,05	–0,325	0,745
Working with databases	2,19	2,00	2,32	2,00	193,53	202,81	–0,822	0,411
Programming	1,86	1,00	2,00	2,00	194,78	205,44	–0,980	0,327
Creating websites	1,72	1,00	1,98	1,00	186,79	211,14	–2,287	0,022

Table 7 Descriptive statistics for first-year students in the analyzed institutions and results of Mann-Whitney test

| Computer skill / competence | Higher education institution | | | | Mann-Whitney test | | | |
| | Polytechnic in Varaždin | | University in Osijek | | Mean rank | | | |
	Mean	Median	Mean	Median	Polytechnic in Varaždin	University in Osijek	Z	p
General computer literacy	3,80	4,00	3,61	3,50	220,29	190,77	2,512	0,012
Word processing	4,09	4,00	4,32	4,00	203,75	238,36	−2,962	0,003
Presentations	3,86	4,00	4,24	4,00	199,81	246,02	−3,876	0,000
Spreadsheets	2,86	3,00	3,50	4,00	193,31	258,66	−5,314	0,000
Using Internet browsers	4,48	5,00	4,55	5,00	211,84	222,62	−1,021	0,307
Using e-mail	4,39	5,00	4,56	5,00	208,57	228,97	−1,865	0,062
Drawing / designing	2,94	3,00	3,32	3,00	203,86	238,14	−2,768	0,006
Using statistical packages	1,73	1,00	1,58	1,00	222,90	201,10	1,925	0,054
Using mathematical packages	1,74	1,00	1,88	2,00	209,78	223,61	−1,199	0,231
Multimedia	2,96	3,00	3,03	3,00	212,42	218,51	−0,493	0,622
Working with databases	2,21	2,00	2,33	2,00	211,28	217,76	−0,536	0,592
Programming	2,10	2,00	2,25	2,00	210,34	225,53	−1,260	0,208
Creating websites	1,90	1,00	2,14	2,00	207,37	231,31	−2,044	0,041

Tab. 6 provides the descriptive statistics for female students at Polytechnic in Varaždin and the Josip Juraj Strossmayer University in Osijek with the results of the Mann-Whitney test. In contrast to male students, in this case higher mean ranks were calculated for female students in Osijek, with the exception of general computer literacy. The reason for this might be the fact that female respondents in the polytechnic sample were mostly students of nursing, where ICT skills and competences are less prominent. According to the Mann-Whitney test, there are significant differences between polytechnic and university female students in the following skills: word processing, creating presentations, working with spreadsheets, using Internet browsers, using e-mail, drawing/designing, and using mathematical packages.

Tab. 7 shows the descriptive statistics for first-year students at Polytechnic in Varaždin and the Josip Juraj Strossmayer University in Osijek, as well as the results of the Mann-Whitney test. Overall, higher mean ranks were calculated for first-year university students in Osijek. The only exceptions are the ratings for general computer literacy and skills in using statistical packages. Therefore, first-year students in Osijek generally rate their ICT skills and competences with higher grades than their counterparts in Varaždin. The results of the Mann-Whitney test indicate that there are six statistically significant differences in the ratings of first-year students, i.e. those at the level $p < 0,05$: general computer literacy, word processing, creating presentations, working with spreadsheets, drawing/designing, and creating websites.

Table 8 Descriptive statistics for students of higher years in the analyzed institutions and results of Mann-Whitney test

| Computer skill / competence | Higher education institution | | | | Mann-Whitney test | | | |
| | Polytechnic in Varaždin | | University in Osijek | | Mean rank | | | |
	Mean	Median	Mean	Median	Polytechnic in Varaždin	University in Osijek	Z	p
General computer literacy	4,27	4,00	3,68	4,00	225,17	154,31	6,271	0,000
Word processing	4,59	5,00	4,37	4,50	193,86	167,34	2,449	0,014
Presentations	4,46	5,00	4,14	4,00	197,30	166,06	2,784	0,005
Spreadsheets	3,78	4,00	3,36	3,00	201,29	164,58	3,138	0,002
Using Internet browsers	4,80	5,00	4,63	5,00	186,26	170,15	1,776	0,076
Using e-mail	4,80	5,00	4,70	5,00	180,72	172,20	0,985	0,325
Drawing / designing	3,67	4,00	3,19	3,00	202,16	164,26	3,207	0,001
Using statistical packages	1,96	2,00	1,61	1,00	204,45	163,42	3,728	0,000
Using mathematical packages	2,47	2,00	1,74	1,00	218,73	158,13	5,341	0,000
Multimedia	3,95	4,00	2,64	3,00	248,40	147,15	8,555	0,000
Working with databases	2,80	3,00	2,27	2,00	207,88	162,15	3,895	0,000
Programming	2,77	3,00	1,94	2,00	226,38	155,30	6,122	0,000
Creating websites	2,87	3,00	2,00	1,00	222,01	156,92	5,620	0,000

Tab. 8 lists the values of means and medians regarding computer literacy ratings of second- and third-year students, and the results of the Mann-Whitney test. In contrast to first-year students, students from higher years at Polytechnic in Varaždin gave higher ratings to their computer skills in all the analysed cases. When comparing this with the results shown in Tab. 7 it can be

noticed that the means calculated for second- and third-year polytechnic students are in all the cases higher than the means calculated for first-year polytechnic students. With university students this is mostly not the case. This result indicates that polytechnic students have a more positive view of the progress they made in computer skills in the course of their studies. According to the Mann-

Whitney test, among the differences in ratings between students of higher years at these two institutions there are only two that are not statistically significant: using Internet browsers and using e-mail.

6
Discussion and conclusion

Computer literacy is essential for every individual in today's world. Given the ubiquity of modern technologies, it would not be wrong to state that people who lack adequate ICT skills cannot rise to the challenges of what is usually referred to as the information age. With highly educated people it goes without saying that they must be proficient in a range of computer skills. This paper looked into the levels of computer literacy among Croatian students at polytechnics and universities, and tried to establish the differences between these two groups.

In this research there are several important and interesting results. Taking into account the ratings of all the students in the sample, it can be concluded that they assess their general ICT competences with relatively high grades, whereas more advanced computer skills are considered to be weaker. Furthermore, the analysis revealed that university students rated more highly basic computer skills, such as word processing, creating presentations, working with spreadsheets, using Internet browsers and using e-mail, and polytechnic students gave higher ratings to advanced skills (using statistical and mathematical packages, working with multimedia, working with databases, programming and creating websites). Male students at Polytechnic in Varaždin gave higher ratings to their computer literacy than their counterparts in Osijek. In contrast, female students at Polytechnic in Varaždin rated their ICT skills lower than female students from Osijek. This result can be explained by the structure of the Varaždin sample: namely, male students were mostly enrolled in technical programmes, and female students were mostly in the nursing programme. There are six programmes of study at the Polytechnic in Varaždin: Electrical Engineering, Mechanical Engineering, Multimedia Design and Application, Technical and Trading Logistics, Civil Engineering, and Nursing. There is no doubt that the organisation of the Polytechnic had an impact on the composition of the sample. One of the results that came out of the research is that first-year students at the Josip Juraj Strossmayer University in Osijek assessed their computer skills more highly than students in Varaždin, whereas it was the other way round with students in higher years.

The obtained results imply that Croatian higher education contributes to the development of general ICT competences, but neglects advanced computer skills. Obviously, ICT needs can differ immensely from user to user and depend on personal and professional preferences. It is therefore logical that a large number of students have no need for mathematical packages, and thus have no skills in using them. Nevertheless, it is a matter of some concern that even students in technical programmes gave relatively low ratings to skills that are certainly important for their future profession (e.g. working with databases, programming, creating websites). These are actually the areas within which the Republic of Croatia should look for recovery and development prospects. Unless there is an upswing in these areas, we will remain the buyers and users of computer applications from abroad, which we could have developed ourselves and offered to the market. Higher education has the task to educate professionals whose knowledge and skills will help in achieving this goal. With adequate development plans for higher education and properly formulated strategies, which will put an emphasis on building computer competences of students, there is still a chance to reverse the current situation and to begin to base the growth of Croatian economy on ICT industries, i.e. on software production and export. Examples such as the USA, India, Australia, the UK, Canada, Russia, Israel and Ireland confirm that this line of thinking is sound and proper. Software industry in these countries did not spring up overnight, rather, the prerequisites for its development had been in the making for years, and higher education played a crucial role in this. Our research will hopefully contribute to the efforts to bring Croatian higher education in line with the economy, and thus to speed up the recovery from the crisis. The results obtained in our research can be used as a basis for planning future activities at our higher education institutions. In this context, the paper is a support in planning the development of Croatian higher education, as well as an incentive for further research.

In order to obtain a more realistic picture of computer literacy among Croatian students, the research should be extended to other polytechnics and universities. Note should be taken here about another issue that might influence the results of our research. Namely, ICT knowledge and skills were not examined directly under controlled conditions; rather, the insights given here are based on respondents' self-assessment. It would have been optimal if students' skills had been tested by means of a standardized test. As this would have been an exceedingly complex and comprehensive exercise, we were not able to proceed in that way. Given the importance of ICT for the improvement of students' professional skills, and thus for their future success, it would be advisable to continuously conduct similar research at the level of the whole country, which of course requires additional resources.

7
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